ENHANCED ENERGY ACCESS FOR URBAN POOR

Best Practice Case Book

UN HABITAT
FOR A BETTER URBAN FUTURE

Acknowledgements

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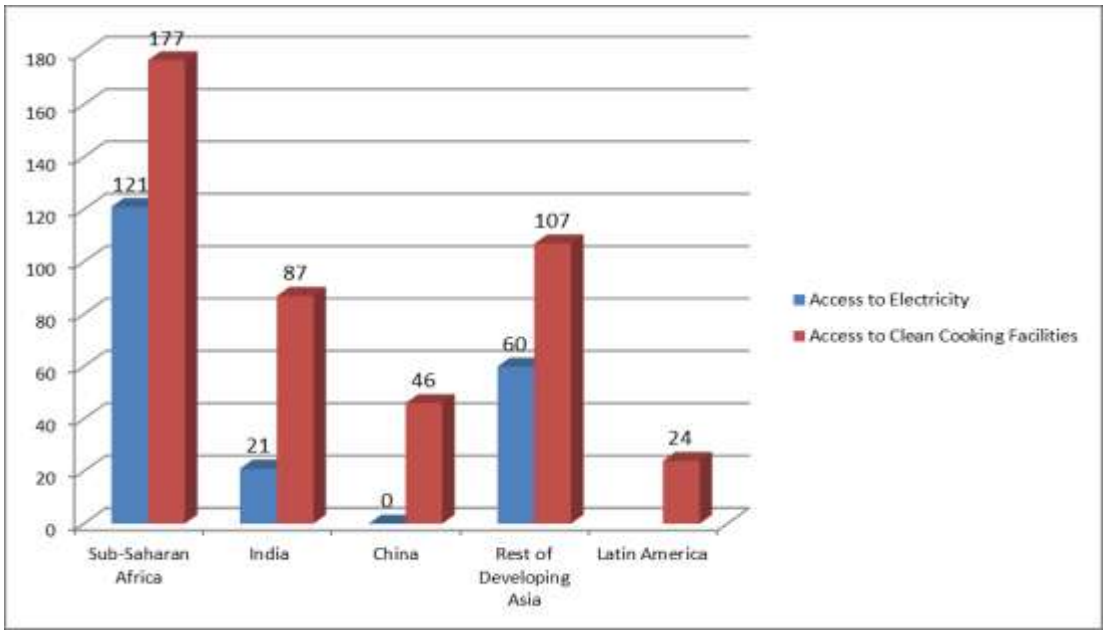
List of Acronyms and Abbreviations

Ah	Ampere hour, unit of battery electrical charge
BRT	Bus Rapid Transit
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFL	Compact Fluorescent Lamp
CNG	Compressed Natural Gas
DALYs	Disability- Adjusted Life Years
EEECO	Energy, Environmental, Empowerment- Cost Optimised Housing
ESMAP	Energy Sector Management Assistance Program
EU	The European Union
FAO	Food and Agriculture Organization
FBE	Free Basic Electricity
GEF	Global Environment Fund
GHG	Green House Gasses
GNF	Global Nature Fund
GPOBA	The Global Partnership on Output-Based Aid
GPS	Global Positioning System
GW	Giga Watts
ICS	Improved Cook Stoves
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
kW	Kilo watts
kWh	Kilo watt hours, energy consumption measure
LED	Light Emitting Diode
LIT	Low Income Tariff
LPG	Liquefied Petroleum Gas
MCEC	Multifunctional Clean Energy Centre
MDGs	Millennium Development Goals
MFI	Micro Finance Institution
MSW	Municipal Solid Waste
NGO	Non-Governmental Organization
PCF	Prototype Carbon Fund
RET	Renewable Energy Technology
SGP	Small Grants Programme
SMEs	Small and Medium Sized Enterprises
SWH	Solar Water Heaters
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
VAT	Value Added Tax
WHO	World Health Organization

Introduction

About 50% of the world's 7 billion people are now urban dwellers. However, the development of infrastructure in cities and towns all over the developing world has been outstripped by the rapid rate of urbanization resulting in the proliferation of informal settlements in densely populated areas. Such settlements pose serious challenges for the economic, social and environmental sustainability of cities. Better work opportunities in cities draw migrants from less endowed rural areas but the rapid rate of urbanization has left cities unable to create sufficient employment opportunities or to provide important basic social and administrative services and infrastructure.

In Latin America for instance, urban poverty surpassed rural poverty over a decade ago. A report by the World Energy Council states that by the year 2000, 63% the region's poor were living in large cities. According to the World Energy Council, rural poverty may be defined as a traditional lifestyle that lacks the devices for providing the comforts of modern life. Urban poverty on the other hand is best defined as the inability to earn an income sufficient to meet the most basic needs including access to energy. Access to modern energy services is crucial for the economic development of communities yet 1.3 billion people do not have access to electricity and 2.7 billion people do not have access to clean cooking energy. In urban areas, people living in informal settlements suffer the most from the lack of access to sustainable energy. Life for the urban poor is characterized by a number of low human development indicators of which low income and energy poverty[1] typified by the lack of adequate and appropriate energy for the basic needs of cooking, warmth, lighting and essential energy services for schools, health centres and income generation are among the most significant and debilitating manifestations.



Urban populations in millions without access to electricity and clean cooking facilities: Adopted from OECD/IEA 2011

According to the International Energy Agency (IEA), a total of 208 million people living in urban areas did not have access to electricity. These include 121 million in Africa, 21 million in India and 60 million people in the rest of developing Asia. The corresponding numbers for Latin America and the Middle East are 4 million and 2 million respectively. The figures for people in urban areas without

[1] The International Energy Agency defines energy poverty as the lack of access to modern energy services including household access to electricity and clean cooking facilities i.e. fuels and stoves that do not cause air pollution in houses.

access to clean cooking facilities are even higher. The total of 441 million includes 177 million in Africa, 87 million in India, 46 million in China, 107 million in the rest of developing Asia and 24 million in Latin America.

The prevalence of urban energy poverty in these regions is caused by the fact that a large portion of the rapidly growing demand stems from low income households in informal settlements who are unable to afford connection costs. Access to energy for the urban poor is also hampered by the widespread lack of pro-poor policies. For example, even though 70% of sub-Saharan Africa's urban population lives in informal settlements. Informal settlements often do not appear on city maps and are routinely excluded from poverty reduction programs. The high mobility of informal settlement inhabitants and the lack of physical addresses and land tenure security are the other main contributory factors to the lack of access to modern energy.

In the absence of modern energy services, the urban poor rely on illegally obtained electricity, kerosene and candles for lighting. They use kerosene and traditional biomass including charcoal, firewood, coal, dung and straw for cooking and heating purposes. Studies have shown that compared to wealthier households, the poorest 20% of households spend a higher proportion of their incomes on these lower quality fuels which cause harmful indoor air pollution. The combustion of solid and non-solid fuels for cooking and heating is the largest contributor to indoor air pollution which is responsible for a significant proportion of the global burden of disease. Indoor air pollution can be linked to acute respiratory infections in children below 5 years of age, chronic obstructive disease, cardiovascular disease and adverse pregnancy outcomes. As shown in the table below, kerosene and traditional biomass burn inefficiently compared to modern fuel sources like electricity and LPG.

Fuel Type	Energy Content (Megajoules)	Energy Content (Kilocalories)	Efficiency
Electricity (kWh)	3.6	860	75%
LPG (kg)	45	10,800	60%
Kerosene (litre)	35	8,400	35%
Charcoal (kg)	30	7,200	22%
Wood (kg)	16	3,840	15%

Energy Content and Efficiency of Different Fuel Sources

In addition to burning inefficiently, the use of charcoal and wood adversely affect the environment contributing to deforestation. They also usually involve high levels of drudgery taking up substantial amounts of time in the lives of women and children who are involved in purchasing or gathering them. Energy poverty therefore ossifies inequity and is inextricably linked to the low livelihoods prevalent in low income urban communities.

While projects to improve access to modern energy have mainly focussed on rural areas, it is important that similar activities also be directed at the urban poor. According to UN Habitat's State of the World Cities report for 2010-2011, by the year 2030, all developing regions, including Asia and Africa will have more people living in urban than rural areas. This fact combined with the health, socio-economic and environmental costs associated with using traditional fuels and the benefits accrued from using modern energy services underscores the importance of ensuring that the urban poor have access to sustainable energy. Another important consideration underlining the importance of promoting universal access to modern energy is that without access to modern energy services, it is almost certain that the global aspirations outlined in the MDGs articulating the world's commitment to improving the lives of informal settlement dwellers will not be achieved within the stipulated timescale.

The benefits associated with access to modern energy include:

- Improved household income with families paying lower prices for legal electricity than they would for electricity sold by exploitative, illegal operators;
- Improved health due to the reduction in indoor air pollution;
- Increased income as people are able to work at night due to the availability of reliable lighting;
- Improved household security as a result of fewer fires and better quality lighting at night;
- Morale boosts in social status associated with households making the transition from social exclusion to social inclusion; and
- The potential to increase educational levels and achievement as children and adult learners have adequate lighting to read and do their schoolwork in the evenings.

Raising awareness of the role of energy for the sustainable development of urban areas is therefore one of the most pressing challenges we currently face. Emphasis should be placed on encouraging cooperation between relevant stakeholders and promoting the sharing and exchange of learning and experiences from successful projects that have adequately addressed the issue of energy poverty. These stakeholders include national governments, international development organizations, finance institutions, the private sector, community groups and poor communities in towns and cities. This casebook documents best practices that have enhanced energy access for the urban poor. The best practices cover UN-Habitat's energy related focus areas, namely energy access, energy efficiency, renewable energy and energy management. They are summarized by type of programme in the table below.

Energy Access	**Slum Electrification** **Energy Market Development** **Public Lighting** **Distribution of Clean Cooking Energy**
Energy Efficiency	**Appropriate Technologies** **Home Retrofitting** **Eco-housing** **Street Light Retrofitting** **Distribution and Promotion of Energy Efficient Lighting Appliances** **Energy Efficiency Awareness Raising** **Sustainable Charcoal Use** **Improved Cook Stoves**
Renewable Energy	**Community, Domestic, Institutional and Industrial Biogas** **Municipal Solid Waste to Energy** **Wind Generated Electricity** **Micro Hydro Power** **Solar PV, Solar Water Heating and Solar Cookers** **Bioenergy**
Energy Management	**Social Tariffs** **Policy and Regulation** **Financing** **Planning** **Partnerships**

Best Practices by UN-Habitat's Energy Related Focus Areas

It should be noted that sometimes the different categories can overlap in one project. The featured best practices illustrate the multiple benefits associated with increased access to modern energy services for the urban poor and document the outcomes, lessons learned and sustainability of the initiatives. With the exception of Barcelona's Solar Obligation, the best practices are drawn from developing countries. They all have clear, measurable goals and have been selected to highlight the

potential of well-implemented programmes and activities. The best practices provide solutions that can be successfully replicated to improve the livelihoods and quality of life of urban poor households.

ENERGY ACCESS: Slum Electrification (1)

Title of Best Practice	The Ahmedabad Slum Electrification Program
City/Town	Ahmedabad
Country	India
Source	www.esmap.org/sites/esmap.org/files/FINAL_EA-Case%20Studies.pdf

Background

Ahmedabad is the largest city in the Western Indian state of Gujarat. Prior to the commencement of the Ahmedabad Slum Electrification program in 2001, poor households in the city's numerous informal settlements had limited access to electricity. Those with access to the electricity grid were illegally connected with a prevalence of extremely energy-inefficient practices resulting in massive losses in revenue for Ahmedabad Electricity Company Limited (AEC). The objectives of the Ahmedabad Slum Electrification Program included ensuring safe and legal electricity supply to the slums establishing an efficient bill collection system and eliminating unauthorized connections.

USAID and *AEC* were the program's lead implementers. Two local NGOs, namely SAATH and Gujarat Mahila Housing Trust (MHT) were tasked with mobilizing the slum community and facilitating access to loans to meet connection costs. USAID, AEC and the beneficiary communities in the informal settlements contributed towards the subsidized connection and wiring costs. Ahmedabad Municipal Corporation (AMC) was responsible for providing the legal framework on which the slum electrification project. This included the provision of security of tenure for households in the informal settlements covered by the program.

Process and Innovation

The program was launched as a pilot in five informal settlements. SAATH and MHT carried out awareness-raising outreach activities to educate the slums dwellers on the advantages of legal electricity connections and energy efficiency practices to help keep their bills low. The connection of the households to the grid commenced after these activities.

Almost universally, none of the households could afford to pay the full connection fees. The innovative approaches that contributed to the success of the slum electrification initiative included a survey conducted by AEC to help determine the level of subsidies that would make the project affordable to the new customers. Another innovation was the issuance by AMC of mid-term (10 year) non-eviction certificates which granted the informal settlement households legal status and security of tenure. This ensured that the electrification exercise could be carried out within a legal framework. The final innovation was the introduction of an instalment mode of payment. Having the option of paying the subsidized connection fees and the subsequent monthly electricity bills over a set period of time made these costs more affordable to the beneficiaries.

Outcomes

A total of 700 informal settlement households had been electrified by the time the pilot phase of the program ended in 2004. The households that were electrified under this phase were unanimous in their enthusiasm for the introduction of regularized electricity. While illegal electricity had proven unreliable, expensive and dangerous, access to legal connections brought with it certainty and added service reliability. Access to legal electricity improved their quality of life and increased productivity. Children were able to study in comfort with better lighting. Further, the electricity bill provided the householders with proof of identity and residence which enabled them to gain access to other important utility services such as gas connections.

AEC on the other hand benefited from reduced service costs and a corresponding drop in the incidence of electricity theft. After the conclusion of the pilot phase of the program, a further 2,000 households were electrified before USAID ended its participation in the slum electrification program. AEC then took charge of all subsequent slum electrification activities and by 2008, all households in Ahmedabad's informal settlements numbering more than 200,000 households had access to legal electricity, receiving and paying electricity bills on a monthly basis. AEC reported a 30% reduction in electricity losses.

Sustainability

The program included energy efficiency training as an essential component of its implementation. This resulted in households using less electricity and therefore paying lower bills. The requirement that beneficiaries contribute to connection costs and their active involvement in the project right from its inception constituted a reliable base for both its financial and long term sustainability. The program also helped to promote women's empowerment with the majority of the connections issued in women's names. The women were actively included in the training and awareness raising activities conducted by SAATH and MHT.

Lessons Learned

The lessons learned included the importance of adopting a gender perspective to household electricity supply in order to ensure that the service provided meets the requirements of the people who are its primary users. This is especially pertinent given the high number of women-headed households in Ahmedabad's informal settlements. Another lesson learned was on the importance of collaborating closely with intermediaries such as the two local NGOs, SAATH AND MHT in extending services to disenfranchised sections of the population. These organizations are well known and highly respected within the community. Their active, high profile participation in the project enabled better communication between the program's lead implementers and the informal settlement households.

The final lesson concerned the importance of adopting the right approach to slum electrification. By successfully doing this, the program demonstrated that electricity utilities are able to compete effectively with illegal service providers. Once electricity connections were regularized and people were ready to pay AEC, the illegal service providers' influence which would have presented a substantial stumbling block to the success of the program was dissipated.

Transferability

The pilot project has already been successfully scaled up in Ahmedabad with the electrification of all of the city's informal settlements. With regards to its transferability outside of Ahmedabad, there have been projects replicating the Ahmedabad model in informal settlements in Mumbai. There has also been interest in using the same approach to electrify informal settlements in Africa.

ENERGY ACCESS: Slum Electrification (2)

Title of Best Practice	EdM Prepayment Project
City/Town	Matola and Maputo
Country	Mozambique
Source	www.unhabitat.org/downloads/docs/7803

Background

Only a small proportion of Mozambique's population has access to modern energy services. Despite the country possessing significant hydro power potential and substantial gas reserves, traditional biomass represents about 80% of the total cooking energy and kerosene lanterns are used by a majority of urban and rural households. Thirty years of armed conflict in Mozambique led to unprecedented migration to urban areas. The majority of these migrants established themselves in informal settlements.

Out of Maputo's population of 1.3 million, 70% live in informal settlements with limited or no access to modern energy services. Matola is located 12 kilometres to the west of Maputo. At one stage, electricity distribution losses in Matola amounted to 43% due to electricity theft, poor distribution grid quality and erroneous billing and collection. In 1995, Electricidade de Mozambique (EdM) the public electricity utility responsible for the transportation and distribution of electricity in Mozambique embarked on a slum electrification project in Matola. The project aimed at regularizing informal settlement electricity consumers. EdM also intended to use the project to improve its operations and its performance.

Process and Innovation

EdM conducted community education sessions to raise awareness about the project. The company then identified customers in the informal settlements who would benefit from the project. These included households previously without access to grid electricity as well as those that relied on illegal connections. The latter were turned into new, legal customers.

Central to the implementation of the project was the installation of pre-paid electricity meters. Similar to pre-paid mobile phone tariffs, pre-paid electricity meters allow subscribers to use only units they have paid for. This constituted the project's main innovation as it was one of the first slum electrification initiatives that utilized pre-paid meters. EdM also adopted a progressive financing approach with the utility paying for connections and subsequently receiving grid expansion credits paid for by the government of Mozambique.

Outcomes

The project started by installing 500 pre-paid meters in low income households in Matola in 1995. This was followed by the installation of prepaid meters for 5,000 more informal settlement households in Maputo in 1996. The project subsequently expanded to include other Mozambican cities and had positive outcomes for the beneficiaries as well as for the utility. The households benefited from better service quality as well as better control of the family budget. For EdM, the pre-payment system and loss reduction measures implemented at the same time as the project enabled its customer base to double in four years. The utility's revenue collection rate improved

from 75% in 1995 to 94% in 2005. In the meantime, the average household electricity consumption dropped from 148 kWh to 124 kWh and total distribution losses decreased from 43% to 18%.

Sustainability

The project's sustainability stems from its financing mechanism. Using EdM capital meant that despite the high costs of installing pre-paid meters, no donor money was needed to implement the project. Better revenue collection and the accompanying loss reduction enabled the utility to recover its financial outlay. The installation of pre-paid meters also stimulated voluntary demand reduction and led to improved revenue collection as well as significant reductions in administrative costs for the electricity utility.

Lessons Learned

While the purchase and installation of pre-paid meters involves high initial costs, the utility and the customers have both benefitted from the fact that that the system has low management costs and does not involve disconnection or reconnection and the attendant charges. Customers benefit greatly from the transparency of the prepaid meter system as they only pay for the electricity that they consume. However, the newly electrified households' consumption and costs would have been reduced even further if the project had provided appliances such as energy saving bulbs and other energy efficient household appliances. Incorporating energy efficiency measures in slum electrification projects can be a very effective demand side management strategy.

Transferability

The project can be successfully replicated by electricity utilities in other cities and informal settlements. However, the high investment cost for pre-paid meters in slum electrification requires a financially strong implementing utility.

ENERGY ACCESS: Slum Electrification (3)

Title of Best Practice	Kenya Slum Electrification Project
City/Town	Nairobi
Country	Kenya
Source	http://siteresources.worldbank.org/EXTAFRREGTOPENERGY/Resources/717305-1264695610003/6743444-1268073502059/5.3.Kenya_periurban_electrification.pdf

Background

Kenya Power and Lighting Company (KPLC) is the sole electricity distributor in Kenya. Research has shown that 80% of KPLC's customers felt that the upfront electricity connection costs are prohibitive. The Kenya Slum Electrification project's objective was to increase connectivity in informal settlements and to improve the livelihoods of low income households by providing them with safe electricity at subsidized connection rates.

Located in Nairobi, Kibera is one of the largest informal settlements in Africa. 73% of Kibera residents live on less than US$ 42 per month. Prior to the project, a World Bank survey found that only 22% of Kibera households had electricity connections. The connections were mainly obtained from illegal providers who emerged in response to the widespread lack of electricity. The service that they provided was more expensive than the KPLC tariff and of poor quality typified by the absence of safety standards. Numerous fires were caused by naked lines running across iron sheets and water.

A carried out by KPLC found that Kibera residents spent 33% of their income on energy related expenditures including illegal electricity, kerosene and dry cell batteries. The utility suffered heavy commercial losses as a result of electricity theft and the proliferation of unplanned loads (pictured left).

The pilot for the Kenya Slum Electrification project started in Kibera in 2007. It was implemented by KPLC and co-funded by the Global Partnership on Output-Based Aid (GPOBA) and the World Bank's International Development Association (IDA).

Process and Innovation

The slum electrification project was pegged to the Government of Kenya's Vision 2030 which has the objective of transforming Kenya into a middle-income economy through the improvement of important infrastructure including energy access. It emphasized stakeholder communication and the involvement of local organizations to engage the community to ensure its successful delivery. The normal fee for new connections at the time was US$ 406. But for the pilot project which was subsidized by GPOBA and IDA, the fee was reduced to US$ 15 and US$ 23 for individual domestic and commercial premises respectively. The reduction in the connection fee, with Kibera households effectively paying less than 4% of the normal connection fee made electricity more affordable and spurred demand for new connections. Part of the funding gap for each household connection amounting to US$ 225 was paid to KPLC by GPOBA and IDA upon independent verification of each household connection. KPLC paid the remaining amount of US$ 166 or 40% of the cost of each individual connection.

The project secured special dispensation from the Energy Regulatory Commission to charge the new customers a flat rate of US$ 3.75 per month for the consumption of 40kW. Cross-subsidization was used to finance the flat rate for Kibera households electrified under the project. This was made possible by tying the project to the government's aim of achieving universal energy access which represents one of the pillars of Vision 2030.

Similar to the EdM project in Mozambique, innovations included the introduction of pre-paid meters. Pre-paid meters help to meet the needs of clients with irregular income while allowing customer flexibility in energy use. The use of pre-paid meters also addressed revenue collection challenges for KPLC and reduced theft opportunities. Further innovations saw the project use GPS and Google Earth to tag beneficiary households. This enabled follow-up to verify that the new connections had indeed been made within Kibera.

Outcomes

The Kibera pilot project targeted 10,000 new customers. For these customers, the benefits accrued included improved quality of life, enhanced safety and security, enhanced economic activity with the new connections enabling them to engage in income generating activities. More than 30% of households in Kibera report that they operate an enterprise. Access to legal, fairly priced electricity can increase their productivity (as pictured left). The new customers also enjoyed the prestige that comes with having access to legal electricity.

For KPLC, the project resulted in a significant reduction in commercial and system losses, enhanced connectivity in line with the company's goal of increasing national electricity access rate to 80% by 2020 and reduced operational costs.

Sustainability

The project has enabled its beneficiaries to replace kerosene and candles as the main lighting sources. This means that they are now less exposed to harmful indoor air pollution leading to improved health outcomes. Access to electricity has also reduced the use of batteries which are harmful to the environment when disposed of haphazardly. The reduction in indoor air pollution and the reduced use of batteries highlight the project's environmental sustainability. The project is also financially sustainable. KPLC has been able to cut its commercial losses in the informal settlement by reducing the influence of illegal power suppliers while improving the company's revenue collection in the process. The use of pre-paid meters with households purchasing and consuming electricity in quantities that they can afford means that there is little risk of beneficiaries falling into arrears.

Lessons Learned

KPLC benefitted from aligning the slum electrification project to the government of Kenya's Vision 2030 which aims to transform Kenya into a middle-income economy. Vision 2030 addresses among development initiatives, the expansion of electricity infrastructure to ensure equity of access to quality energy services. This helped facilitate the implementation of project measures such as the the flat monthly rate for 40kW of electricity consumed by Kibera customers.

Transferability

Slum electrification projects have a high chance of succeeding when they are undertaken with the commitment of the power utility and the support of the government and other stakeholders at all levels including landlords and householders. There are plans to replicate the Kibera pilot project in other informal settlements in Kenya

ENERGY ACCESS: Slum Electrification (4)

Title of Best Practice	LYDEC Temporary Lower Cost Mini-grid Electrification Program
City/Town	Casablanca
Country	Morocco
Source	http://www.unhabitat.org/downloads/docs/7803_91408_Overview%20of%20Slum%20Electrification%20in%20Africa.Final%20report.pdf

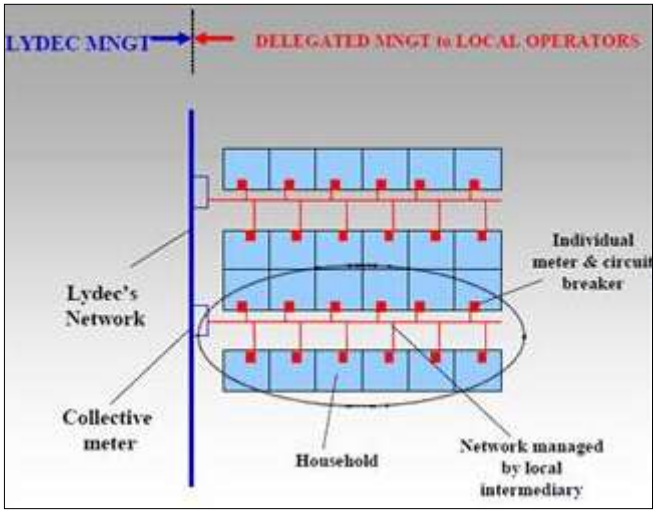
Background

Lack of security tenure in informal settlements means that demolition and eviction are ever-present threats for many urban poor households. Electricity utilities are reluctant to develop infrastructure in informal settlements due to the lack of security of tenure coupled with the high mobility of the populations that live in these areas. Electricity theft leading to heavy commercial losses for utilities is commonplace because while illegal, it often represents the only way that households in informal settlements can get access to modern energy. Casablanca's informal settlements were initially located at the city's periphery. They have since extended to within the city's boundaries. In the years up to and including 1997, Casablanca's electricity utility was losing revenue in the order of millions of dollars every year to electricity theft.

In 1997, Lyonnaise des Eaux Casablanca (LYDEC) a private sector consortium was given the responsibility of managing the city's essential urban services including electricity, water and sanitation under a thirty year management contract. The main objective of the contract was to provide access to essential services to Casablanca's 4.5 million residents 30% of whom lived in informal settlements. The LYDEC Temporary Lower Cost Mini-grid Electrification program targeted 130 informal settlements, about 159,000 households where electricity was mainly supplied through illegal connections.

Process and Innovation

LYDEC's previous efforts to curb electricity theft through disconnections had proved unsuccessful. With input from employees of RAD, the utility company that was previously responsible for the distribution of electricity in Casablanca, LYDEC introduced the Temporary Lower Cost Mini-grid Electrification program in 2004. The program erected mini-grids (pictured left) which were maintained and managed by local community representatives nominated by householders in the informal settlements. Transformers and collective master meters were situated at the perimeter of the informal settlements or in easily accessible areas within the informal settlements to allow their quick removal if the municipality decided to demolish the settlements.



LYDEC provided the community representatives with the requisite managerial and technical training. The company also provided materials and technical assistance and local communities were able to reduce the cost of the project by providing labour. Households benefitting from connections under the program each paid a fee of US$ 130. The community representatives acted as trusted intermediaries between LYDEC and the community. Each

representative was responsible for managing a mini-grid network supplying about 20 households and for collecting the households' shares of the electricity bills.

The program's main innovation lay in its use of community representatives. Delegating important aspects of the delivery of the program to people drawn from within the local communities helped cut investment costs and also had the effect of improving LYDEC's relationships with the community.

Outcomes
The program posted impressive results. Within a few years, it had created 3,500 new jobs including 1,250 community representative positions. By 2007, three years after the commencement of the program, 30,000 households in 120 informal settlements in Casablanca had legal access to electricity through connections to mini-grids. 96% of the money owed by the new customers in bills to LYDEC was being recovered meaning that the default rate was only 4%. The number of new businesses in the informal settlements also increased significantly following electrification.

By enhancing access to legal electricity for low income consumers, LYDEC improved the living conditions of thousands of Casablanca's households and reduced average monthly household electricity budgets by an estimated US$ 10. The program also improved conditions for the education of children and young people who had previously depended on street lighting or used candles and gas lamps to read and study in the evening.

Sustainability
To ensure the sustainability of the program, LYDEC provided conceptual and technical assistance to both electricians and local community representatives. This had the effect of allowing standardization as well as the effective management of the mini-grids. As a result of the project, LYDEC became a profitable business ranked among the top 15 companies in Morocco highlighting the program's financial sustainability. LYDEC effectively met the needs of the urban poor by providing quality services at affordable rates illustrating in the process that public-private partnerships with active community participation can result in better living standards for low income households and communities.

Lessons Learned
The success of LYDEC's relatively simple and low cost approach may be attributed to the orderly layout of the slum households and the social cohesiveness of the communities in Casablanca's informal settlements. Another factor contributing to the program's success was LYDEC's decision to retain former employees of RAD and actively seek their input. This enabled the program to benefit from their know-how and their years of experience in the Moroccan electricity sector. LYDEC's success in implementing the Temporary Lower Cost Mini-grid Electrification program illustrated that slum electrification projects can be successful even in the face of the immense challenge posed by lack of security of tenure in informal settlements.

Transferability
LYDEC's use of mini-grids managed by the community represented a new approach to slum electrification. The efficacy of the approach has seen it successfully replicated in other Moroccan cities like Tangier-Tetouan and Rabat.

ENERGY ACCESS: Slum Electrification (5)

Title of Best Practice	The Barrio Eléctrico Initiative
City/Town	Caracas
Country	Venezuela
Source	http://www.wbcsd.ch/DocRoot/6T5iV7ch7uXBlYSusYtf/AESEDCfull_final_web.pdf

Background

AES Corporation supplies electricity to 6 million people in Venezuela including the population of Caracas the country's capital city. It is one of the largest power companies in the world with a presence in 28 countries. More than half of the residents of Caracas live in informal settlements above the city. With neither security of tenure nor legal rights to their dwellings, people living in the informal settlements could not get legal electricity connections. AES shunned customers without property rights and only supplied electricity to areas of Caracas whose urban development had been approved by the municipal authorities. The utility only connected unplanned communities if the municipal authorities commissioned the installation of power lines.

This led to the proliferation of electricity theft with sharp increases in AES' financial losses which were exacerbated by the rapid population growth in informal settlements in Caracas. In the year 2000, electricity theft was estimated at 12% of energy produced costing AES US$ 35 million in lost revenue. The numbers of accidents caused by hazardous, unstandardized illegal connections (pictured left) were also on the rise.

The Barrio Eléctrico (electric shantytown) Initiative was aimed at turning Caracas' illegal consumers of electricity into paying customers. AES also aimed to use the initiative to reduce non-technical losses attributed to electricity theft thereby strengthening the company's finances while at the same time increasing the reliability and security of electrical connections and improving the quality of life for people in the city's informal settlements.

Process and Innovation

In 2003, AES launched the pilot phase of the Barrio Eléctrico Initiative in Barrio La Morán a low income neighborhood with a population of 20,000. AES hired social workers to establish working relationships with the community, to promote the initiative and to persuade residents on the benefits of having a legal electricity connection. The newly connected customers paid a flat rate of US$ 1.5 for the first 200 kWh of electricity used per month.

The initiative's main innovation was the installation of collective meters for customers who were unable to afford the price of individual connections. Residents connected to the collective meters coordinated the payment of their individual bills. AES also allowed a level of payment delays for the poorest customers with irregular incomes.

Outcomes

Electricity supply to Barrio La Morán became more reliable with appliance repair costs associated with power surges decreasing substantially. The success of the Barrio La Morán pilot led to the initiative being replicated in other informal settlements around Caracas. Community leaders (pictured left) were trained to act as liaisons between the community and the utility.

The newly legalized customers were able to operate businesses that required a reliable and stable supply of electricity. Social benefits included the enhancement of security in the informal settlements resulting from the installation of street lights as well as a reduction in the incidence of accidents related to dangerous electricity connections. People from the newly regularized informal settlements who previously had no access to mainstream services such as banking services were able to open their own accounts, an outcome attributable to the Barrio Eléctrico Initiative.

Sustainability

The Barrio Eléctrico Initiative proved to be operationally sustainable. AES was able to reduce electricity losses, increase its customer base by 30% and improve service quality through innovative distribution and billing practices. The company's customer base increased by about 110,000 households and reached 460,000 in 2006. The solution advanced by AES has provided safe, reliable energy to poor residents while at the same time proving a profitable business model for the electricity utility.

Lessons Learned

The initiative highlighted the fact that low income households also want a better, more reliable supply of electricity and are willing to meet the costs of being legal consumers once the bottlenecks associated with the process of becoming legally connected have been addressed. To achieve this, the participation of the community in the initiative was crucial and enabled AES to review its operational strategy to respond to the needs of the urban poor. The consumers in turn benefited from the introduction of greater flexibility in the company's conditions of service making this a vital component in the success of the initiative.

Transferability

After replicating the Barrio Eléctrico Initiative in other informal settlements in Caracas, AES aims to provide electricity services to low income households across Latin America. The success of the initiative will enable the company to replicate the model across the region in countries where it operates and where similar problems exist with regard to illegal electricity connections.

ENERGY ACCESS: Slum Electrification (6)

Title of Best Practice	COELBA Community Agent Project
City/Town	Salvador
Country	Brazil
Source	http://www.esmap.org/sites/esmap.org/files/Improving%20Energy%20Access%20to%20the%20Urban%20Poor_TERI_Nov%202011.pdf

Background

With a population of about 2.7 million, Salvador is the third largest city in Brazil. 35% of the city's population live at or below the poverty level. Salvador has more than 350 informal settlements which are home to about 800,000 people. Rapid, unplanned urbanization has led to attendant urban problems including high rates of unemployment, poor living conditions and limited access to regular, quality energy services.

Following the privatization of the energy sector in 1995, Brazilian electricity utilities realized that illegal use of electricity was widespread resulting in substantial system losses and significant public safety concerns brought about by overloading and poor wiring practice. Illegally connected households were accustomed to high levels of electricity consumption due to the use of low efficiency light bulbs, faulty connections and refrigerators in poor condition. Houses in informal settlements constructed with no ventilation and natural lighting required the constant use of fans and electrical lighting.

Companhia de Electricidade do Estado da Bahia (COELBA) is a private electricity distributor operating in the state of Bahia where Salvador is located. Statewide, about 50% to 60% of COELBA customers can be classified as low income. The utility initiated the Community Agent Project to address the high levels of technical and commercial system losses, to combat inefficiency and to ensure access to legal electricity for low income consumers. COELBA funded the project which was delivered in partnership with AVSI Foundation. AVSI Foundation is an Italian non-profit organization involved in slum upgrading. Other project implementation partners included Cooperação para o Desenvolvimento e Moradora Humana a local slum upgrading and community development organization and several local community associations.

Process and Innovation

The first phase of the Community Agent Project was launched in 2000 targeting 200,000 households in Salvador. Cooperação para o Desenvolvimento e Moradora was responsible for hiring, training and supervising community agents. The community agents would be responsible for reaching the communities in informal settlements, conducting public education sessions on the importance of regularized electricity and efficient consumption. They also worked to establish relationships based on mutual trust between communities in the informal settlements and COELBA.

One of the challenges faced by the project was keeping the newly regularized customers from defaulting on their bills. This was overcome by using the community agents as mediators delivering information on energy efficiency improvements that lowered household electricity bills. This represented the project's main innovation which was its ability to successfully devise an approach that effectively addressed COELBA's interests while also taking the financial limitations of low income customers into consideration ensuring that an effective and lasting solution was achieved. Old, inefficient appliances like light bulbs, and refrigerators were exchanged for new, more efficient appliances offered to the households at a fraction of their retail prices.

Outcomes
As planned, the first phase of the project regularized electricity supply in 200,000 households. By 2010, the project had created employment opportunities for more than 100 community agents and 200 technicians. More than 525,000 energy efficient light bulbs had been distributed and more than 51,000 refrigerators had been distributed among beneficiary households. An additional 18,000 refrigerators had been sold to the newly regularized customers. The electricity bills paid by the low income customers was substantially reduced through a combination of energy efficiency measures which on average reduced electricity consumption by about 21% and registration in Brazil's Social Tariff Program which offers subsidized electricity rates for bottom of the pyramid customers. For a household registered in the Social Tariff program, the reduction in consumption was found to be equivalent to cost savings of one-third on average monthly electricity bills.

Post-project surveys have shown high levels of customer satisfaction as well as significant improvements in consumers' perception of COELBA and increased safety and security due to the standardized wiring which had the effect of reducing the households' exposure to accidents. COELBA successfully achieved its objective of curbing the default rate among customers regularized by the Community Agent Project. In 2009, the default rate among these customers was 26%, a figure that was much lower than that recorded in other low income neighborhoods of Salvador.

Sustainability
The project reduced system losses as well as the levels of consumer debt. It improved the well-being of the beneficiary communities with savings made on the electricity bills being spent on essential items like food, health, education and clothing. The project also had a positive environmental impact. The Chlorofluorocarbon (CFC) gas used in old refrigerators has a destructive effect on the Ozone layer. The recycling of CFC is therefore highly beneficial to the environment.
The old refrigerators recovered by the project were collected and the scrap metal and CFC sold to raise money for local projects administered through a Social Action Fund.

Lessons Learned
The community agent methodology adopted by COELBA was successful mainly because it enabled the project to have at its disposal people who were familiar with the challenges and hardships faced by the target beneficiaries. The agents could relate and communicate with the communities in the informal settlements on a personal level making them more responsive to the project activities and improving their perception of regularized electricity and the utility. Another important factor contributing to the success of the project was the fact that it linked regularization of electrical services with energy efficiency and the Social Tariff program. These measures enabled customers to make substantial savings on their monthly bills. Additionally, the slum upgrading initiatives undertaken by AVSI Foundation aided project delivery by improving the designs of the houses targeted by the initiative. The poor construction of the houses in Salvador's informal settlements had been a contributory factor to high levels of household energy consumption.

Transferability
The project has been successfully replicated in other informal settlements in Bahia and in neighboring states like Pernambuco.

ENERGY ACCESS: Slum Electrification (7)

Title of Best Practice	Local Action for Social Sustainability
City/Town	Betim
Country	Brazil
Source	http://www.iclei.org.br/polics/CD/P2_4_Estudos%20de%20Caso/3_Eficiencia%20Energetica/PDF113_EC115_Betim_ing.pdf

Background

Betim is a city in the metropolitan region of Belo Horizonte the capital of the Brazilian state of Minas Gerais. There are numerous unplanned and informal urban settlements in Betim. Prior to the implementation of the Local Action for Social Sustainability project, the households in the informal settlement of Parque do Cedro obtained their electricity illegally as the neighbourhood was not eligible for formal electricity supply. Incentives to use electricity safely and efficiently were non-existent leading to frequent accidents and wastage of electricity.

The Local Action for Social Sustainability project sought to promote sustainability and to make basic services accessible for the residents of Parque do Cedro. It was undertaken by a partnership that included the local community, the electricity utility Minas Gerais Energy Company (CEMIG), the municipal government and the city of Betim's Renewable Energy and Energy Efficiency Reference Centre (CRER).

Process and Innovation

The residents of Parque do Cedro formed a representative commission which approached the municipal government seeking to prioritize the needs of the neighbourhood for basic services as well as to improve their living conditions. In 2008, Parque do Cedro was reclassified. The reclassification meant that the neighbourhood went from being an informal settlement to become a legal area of urban and socio-environmental interest providing the legal framework for the community to gain access to services. This was done through the enactment of Law Number 4574 which changed the city's Master Plan and permitted government action in the neighbourhood and CEMIG was able to provide reliable and legal electricity connections to households that were previously reliant on illegal connections. CRER was responsible for raising awareness and educating community members on the benefits of efficient utilization of electricity.

The project's main innovation lay in its adaptation of a bottom up approach. The Parque do Cedro community organized itself and agitated for the removal of what had previously appeared to be insurmountable political and bureaucratic obstacles to the extension of basic services to the informal settlement. The removal of these obstacles leading to the reclassification of Parque do Cedro as a legal area of urban and socio-environmental interest paved the way for the project implementers and the community to achieve their shared objective of legalizing electricity connections in the informal settlement.

Outcomes

By 2010, all the 400 households in Parque do Cedro had access to legal electricity connections. 285 more households had their old electrical appliances replaced with energy efficient appliances including refrigerators, electric shower heads and energy efficient lighting bulbs. These were donated by CEMIG. The project has proved to be an important step toward social inclusion for residents of Parque do cedro. It also put an end to illegal connections in the area and reduced revenue losses for CEMIG.

Sustainability
The Local Action for Social Sustainability project has led to substantial savings for the residents of Parque do Cedro and for the electricity company highlighting its financial sustainability. The householders have ended up paying less for their electricity compared to when they were illegally connected. For CEMIG, there has been less service disruption and an increase in revenue collected as a result of formalizing the electricity supply and mainstreaming a previously disenfranchised community. The supply of safe and legal electricity has reduced the number of accidents caused by hazardous wiring, distribution and loading practices that were recurring features of illegal electricity supply making it operationally sustainable.

Lessons Learned
Residents of informal settlements often find themselves sidelined by utilities and local governments due to their illegality. In such cases citizen action and advocacy encompassing the formation of strategic alliances with players in the energy sector can be effective in addressing the lack of service provision. This is exemplified by the Local Action for Social Sustainability project which demonstrated that community organization and a grassroots level approach can lead to transformative improvements in previously marginalized communities.

The awareness raising and education conducted by CREC proved to be essential for the adoption of the energy efficiency measures that accompanied the legal electrification of Parque do Cedro households. The project benefitted greatly from the establishment of a communication channel with members of the community which was used to inform them of what was going on and to provide updates on the progress made. This openness meant that the project enjoyed widespread support within the community.

Also of great importance to the project's success was the enabling environment brought about by pro-poor legislation passed by municipal and national governments. Law Number 4574 and the Land Tenure Regularization of Special Social Interest Zones under Chapter VI of Law 8.137 of December 2000 allow for the re-classification of marginalized neighbourhoods from informal settlements to areas of social, urban and environmental interest and government investment.

Transferability
Community participation proved to be a vital ingredient for the success of the Local Action for Sustainability project. The project can be replicated in other informal settlements with similar demographics to Betim's Parque do Cedro once the community's collaboration is assured.

ENERGY ACCESS: Energy Market Development (8)

Title of Best Practice	Lighting Africa Project
Country	Sub-Saharan Africa
Source	http://siteresources.worldbank.org/INTAFRICA/Resources/FINAL_STORY_green-growth-lighting-africa.pdf

Background

121 million people living in towns and cities sub-Saharan Africa do not have access to electricity. The Lighting Africa project was designed to address the lighting needs of low income households and businesses. The project was meant to offer a lighting alternative for low income consumers who relied on kerosene lamps, candles or battery powered torches. The project also aimed to contribute to the realization of the MDGs by reducing poverty and enhancing quality of life for low income households.

Lighting Africa is a joint venture between the World Bank and the International Finance Corporation (IFC). Other organizations involved in the project include the Africa Renewable Energy Access Grants Program, the Climate and Development Knowledge Network, the Global Partnership on Output-Based Aid (GPOBA), the Energy Sector Management Assistance Program (ESMAP), the Global Environment Fund (GEF), the Public Private Infrastructure Advisory Facility, the Renewable Energy and Energy Efficiency Partnership and the governments of Italy, Luxembourg, the Netherlands, the United States and Norway. The project seeks to accelerate the development of commercial off-grid lighting markets in sub-Saharan Africa by mobilizing the private sector to build sustainable markets. The markets are intended to provide affordable, modern off-grid lighting to communities without access to grid electricity.

Process and Innovation

Lighting Africa was piloted in Kenya and Ghana between 2008 and 2010. The project tested and promoted products that passed the Lighting Africa quality tests, provided practical support for manufacturers to improve their products and raised consumer awareness on quality lighting products. It also educated customers on the benefits of solar lighting over kerosene while offering new technology advances in lighting such as Compact Fluorescent Lamps (CFLs) and Light Emitting Diodes (LEDs) which are clean, durable and typically provide higher quality lighting.

Lighting Africa's innovations included the rewarding of outstanding clean lighting products, the publishing of technical briefing notes providing manufacturers with information to help them design and improve their lighting products as well as the use of market intelligence. The market intelligence contained market insight reports that could be used by the industry to develop products, enter the market and mobilize investors. By doing this the project was able to make quality, off-grid lighting products more available to low income households and businesses in Africa while bolstering local commerce and creating new employment opportunities.

Outcomes

As a result of the Lighting Africa project, there were 6.4 million people with better lighting and increased energy access using solar lanterns in both urban and rural households in Africa by December 2012. 1,280,000 quality off-grid lighting products had been sold. These products had passed Lighting Africa's minimum quality standards. About 80,000 tons of Green House Gas (GHG) emissions had been avoided. To help consumers meet the relatively high upfront costs of the lighting products that passed Lighting Africa's quality tests, the project works with Micro Finance

Institutions (MFIs) which provide loans to low income households. In Kenya alone, loans totalling US$ 500,000 have been disbursed

The initiative also established the first testing laboratory in East Africa. Housed at the University of Nairobi, the laboratory is used to test off-grid lighting products as a commercial service to manufacturers and distributors. Another outcome of the project is that there are reputable institutions that employ Lighting Africa's test methods. The United Nations Framework Convention on Climate Change (UNFCCC) employs the Lighting Africa quality testing methodology for Clean Development Mechanism (CDM) compliance.

Sustainability

Kerosene lamps and candles emit poor quality light and are known to release significant amounts of GHG into the atmosphere. Having access to cleaner modern energy enables such households to reduce the amount of carbon dioxide emitted by their lighting appliances underlining the Lighting Africa project's environmental sustainability. The use of kerosene for lighting costs up to one-third of poor households' incomes. The products which have passed Lighting Africa's quality testing turn out to be cheaper in the long run making the project financially sustainable.

The project is also operationally sustainable. The introduction of international quality specifications and a testing methodology for off-grid lighting products ensures that consumers have access to high quality goods and serves to increase confidence in the burgeoning market. The standards help distinguish good and bad quality products which is especially important at a time when there is a proliferation of sub-standard quality products in the market which erode consumer confidence. Lighting Africa supported the establishment of the Global Off-Grid Lighting Association which aims to promote quality off-grid lighting in the developing world. The association will build on the quality assurance work that Lighting Africa has done. This will ensure that the off-grid lighting industry will continue the work that Lighting Africa kick-started.

Lessons Learned

A market transformation approach like the one adopted by Lighting Africa is likely to succeed if there is a sizable commercial market opportunity, strong investment incentives and private-sector motivation. It also requires a solution based on superior technology tailored to market needs and evidence of common market barriers that prevent market penetration. The latter involves assessing market potential to establish whether there is a sizable commercial market opportunity and sufficient demand as well as assessing the local business environment to find out if there is sufficient investment incentive for the industry to gain confidence in the emerging-market opportunity.

Transferability

Lighting Africa has expanded to Tanzania, Senegal and Ethiopia. A Lighting Asia-India program, inspired by the Lighting Africa experience started in May 2012.

ENERGY ACCESS: Public Lighting (9)

Title of Best Practice	Adopt a Light Slum Lighting Project
City/Town	Nairobi
Country	Kenya
Source	www.unhabitat.org/downloads/docs/6855_19838_AdoptaLight.pdf

Background

Informal settlements are home to more than 60% of Nairobi's population. They are generally described as havens of crime lacking modern energy, sanitation and other social amenities. There is strong evidence linking poor lighting to high levels of crime and insecurity as a result of which many commercial and productive activities in informal settlements stop at nightfall. The Adopt a Light Slum Lighting project had the objective of lighting public spaces in informal settlements in Nairobi in order to improve security and make them safer for residents.

The main force behind the project was Adopt a Light Limited an advertising company headquartered in Nairobi. Project partners included the Nairobi City Council, the Kenyan Parliament through the Constituency Development Fund, private sector companies and the communities in the informal settlements targeted by the project.

Process and Innovation

Adopt a Light Limited recognized that outdoor advertising could be utilized to provide a viable solution to address the challenge of non-existent or decaying lighting infrastructure in informal settlements. However, the project had to overcome challenges the most prominent of which were convincing the city council to participate in the project and gaining access to sites in the informal settlements where the lighting systems would be erected. Project approval was obtained after negotiations with the City Council. The challenge of access to the sites was resolved through a series of consultative meetings held with community level administrators and community leaders. An agreement was reached whereby people who had to relocate to enable the erection of the lighting systems were compensated by the project.

With the challenges resolved, businesses were approached with the offer of unique outdoor advertising opportunities. High masts were identified as the most appropriate, least destructive and cost-effective means of lighting up the neighborhoods. The businesses would adopt 30-metre high light masts to carry their messages as they contributed towards the development of public infrastructure.

The erection of high light masts in the informal settlements commenced in late 2005 with the businesses paying to have their advertisements carried on their "adopted" mast for a predetermined period of time based on the value of their sponsorship. The funds generated from the installation or renewal of high light masts from street lights in other parts of the city that were more attractive to advertisers (pictured above left) were used to subsidize the expansion of infrastructure to informal settlements where advertising was likely to have minimal effect on product sales or brand awareness.

Outcomes

A total of 33 high light masts (pictured below) were installed in informal settlements in Nairobi including Kibera, Mathare, Korogocho, Huruma, Kawangware and Kangemi. The masts served in excess of 500,000 people in 150,000 households.

In 2006, an evaluation of the project conducted by Steadman Kenya Limited a respected market research company now renamed Synovate Ipsos Kenya Limited concluded that in addition to improving neighbourhood security, the project had succeeded in providing a conducive environment for productive economic activities. Business hours had increased within the lit areas. Fewer cases of mugging and harassment were recorded in the lit areas compared to unlit areas.

The project has won several awards including the Mayoral Achievement Award from the City Council of Nairobi and UN-Habitat's Business Award for Sustainable Urbanization.

Sustainability

By financing lighting infrastructure, the project has saved Nairobi City Council significant amounts of money allowing the local authority to focus on other areas of need such as education, health and garbage collection. Its financial sustainability has been assured by the successful promotion of the concept to businesses. The number of sponsors increased during the course of the project to more than 100 organizations. These organizations had been attracted by the project's positive social impact and the effectiveness of its advertising services.

Lessons Learned

The Adopt a Light project underscored the importance of community participation demonstrating that poor urban communities can be supportive of initiatives that impact positively on their lives. Consultation with such communities is essential if resistance, misunderstanding, unnecessary delays and the resultant additional costs which endanger timely project implementation are to be avoided. The project also illustrated that well-structured public-private partnerships can deliver important results. It showed that with the right approach, the private sector can be mobilized to help finance the improvement of public infrastructure.

Transferability

The project is easily replicable once the support of the private sector and other potential advertisers has been secured. Following on from the success of the project in Nairobi, many local authorities in Kenya and in the East African region have invited the private sector to participate in similar public lighting initiatives.

ENERGY ACCESS: Clean Cooking Energy (10)

Title of Best Practice	The Fundación Pro Vivienda Social Gas Project
City/Town	Buenos Aires
Country	Argentina
Source	http://www.hystra.com/opensource/HYSTRA_Access_to%20_Energy.pdf

Background

Between 1947 and 1960, the population of the neighborhoods bordering Buenos Aires grew by more than 10 million. This was as a result of migration from rural Argentina and from neighbouring countries. The migration was spurred by the growth of small and medium-sized industry in Buenos Aires and happened in a chaotic manner in the absence of planning and organization leading to the proliferation of informal settlements. A large proportion of these neighborhoods suffered from high levels of social deprivation. By the late 1990s, about 3 million people in the Buenos Aires metropolitan area had no gas grid connections. The main fuels used for cooking and heating in the informal settlements of Buenos Aires are coal, firewood and illegally obtained natural gas. The cost of connecting these households to the natural gas grid was considered prohibitive. The households lacked access to credit and the utilities perceived the areas as too high risk to warrant the significant investment required to connect them to the natural gas grid.

The gas distribution company is not obliged to expand its network. Traditionally, gas network expansion is done through an arrangement between the municipal government and a gas line construction company. The company meets the cost of the new line and receives payment from the government after taxes on the line are paid. The companies are understandably reluctant to supply gas to low income communities where the taxes may not be paid. The Fundación Pro Vivienda Social (FPVS) a non-profit organization initiated the FPVS Gas project as a result of a survey of the needs of the residents of an informal settlement known as Cuartel V. From the survey, financing for connection which was supposed to be paid upfront emerged as the main hindrance for poorer households wishing to have access to piped natural gas. The FPVS Gas project started as a pilot in Cuartel V. The project's objective was to connect low income households to the gas grid by helping them meet the connection costs. It was undertaken with funding from the World Bank and a development fund loan from Fondo de Capital Social (FONCAP).

Process and Innovation

The Cuartel V pilot project commenced in 2000. FPVS mobilized community members and other stakeholders including the World Bank, FONCAP, the gas utility responsible for supplying the gas and the gas line constructors responsible for expanding the gas network. This grouping led to the formation of a trust fund for holding the project finances. The trust fund was administered by FPVS which was also responsible for project leadership. The Cuartel V community owned the trust fund and was also responsible for the promotion and marketing of the project in the informal settlement. 3,000 households were selected as beneficiaries of the pilot phase of the project.

The use of the communally owned trust fund represented a new approach for the provision of access to gas for the residents of informal settlements. It demonstrated that members of disadvantaged communities could in fact be credit-worthy. They already consumed gas and in some cases even ended up paying more for the commodity than legally connected wealthier households.

Outcomes

The main gas line in Cuartel V was inaugurated in 2003 and the first internal connections were made in May 2004. The project resulted in households paying on average four times less for their energy needs as a result of the shift to piped natural gas.

About 100 local jobs were created as a result of the pilot project which was accompanied by a 30% drop in the incidence of respiratory illnesses in the beneficiary households. The financial savings realized as a result of the project led to greater spending in local businesses and even enabled the beneficiaries to make some home improvements.

Sustainability

The operational sustainability of the FPVS Gas project was highlighted by the low default rates among the community in Cuartel V which was recorded at between 4% and 6%. This was significantly lower than the average among subscribers in less disadvantaged areas both nationally and in Buenos Aires. The project's financial sustainability was underlined by the fact that its delivery did not rely on any subsidies. The project is also environmentally sustainable. Harmful indoor air pollution was eliminated for the households that benefitted from the FPVS Gas project.

Lessons Learned

The lack of formal property rights and the lack of infrastructure meant that the urban poor in neighborhoods such as Cuartel V ended up stuck in a vicious cycle. Because they are not integrated into the banking system, they cannot save money or access credit for any capital investments. The FPVS Gas project highlighted the fact that the community was willing to pay for services especially when access to these services lead to financial savings. The other lesson learned concerned investment by the private sector into informal settlements. This is often hampered by the lack of market research which would inform investors of the potential benefits of ventures that address the needs of poor communities.

Transferability

The project is easily transferable to urban poor households in countries with sufficient supplies of natural gas. Its success relied mainly on strong community participation and smooth collaboration between the multiple stakeholders involved. These conditions would have to be in place to ensure the success of initiatives seeking to replicate the success enjoyed by the FPVS Gas project.

ENERGY ACCESS: Clean Cooking Energy (11)

Title of Best Practice	The Community Cooker
City/Town	Nairobi
Country	Kenya
Source	http://www.planning-kenya.com/downloads/Community_Cooker_Brochure.pdf

Background

The waste generated by households and businesses in informal settlements is disposed of in a haphazard manner by the roadside or in illegal dump sites. The waste ends up degrading the environment and polluting groundwater. The Community Cooker (Jiko ya Jamii in Kiswahili) incinerates waste to provide informal settlement residents with low cost heat for cooking and boiling water while improving the local environment.

The Community Cooker project was initiated by Planning Systems. A prototype Community Cooker constructed in Kibera in Nairobi was financed by UNEP and is run by Ushirika Wa Usafi Kibera (Fellowship for Cleanliness) a local community organization. The project addresses the accumulation of rubbish in informal settlements while mitigating deforestation in areas where charcoal and firewood are the main cooking fuels. It also reduces ground water pollution. The Community Cooker Foundation is responsible for disseminating the technology.

Process and Innovation

The first community cooker was constructed in 2008. The cooker is powered by dried rubbish, collected by residents of Kibera who in return for supplying rubbish can cook or heat water for drinking and washing free of charge. It works in three steps which include collecting the rubbish, sorting the rubbish and incinerating the rubbish. The cooker (pictured left) is made of welded steel insulated with fire bricks. The top of the cooker consists of a metal plate covering 1.7 metres squared and serves as the cooking surface. The cooker has two ovens for baking. A chimney carries the smoke from the combustion chamber to the chimney's outlet.

At the bottom of the cooker, there is a wide metal chute that allows rubbish to be pushed from the trash storage racks into the combustion chamber of the stove. Dry, sorted rubbish is manually fed by a stove operator. Because the stove burns rubbish at over 800^{o}C, it achieves 99% combustion producing smoke that is white and almost odourless. Once completely ignited, the cooker can operate for up to 24 hours a day with minimal running costs. Dripping sump oil and water onto a super-heated steel plate aids incineration and ensures that temperatures remain at the desired levels above 800 ^{o}C eliminating the toxins that would otherwise be produced from burning plastic and other inorganic waste material.

Project innovations include the fact that in addition to providing the community with access to a clean cooking fuel, it has contributed to waste management, addressing sanitation and health issues. The project has also introduced alternative payment methods enabling cash-strapped community members to use the cooker in exchange for bringing rubbish to the site of the cooker.

Outcomes

The project employs seven young people who sort the solid waste removing objects that can be recycled, including glass and some plastics. Food and plant waste, such as banana skins and potato peelings, are separated out too so they can be used for making compost. The rest is burned in the cooker. The cooker is lit three times a week. Community members either pay the equivalent of US$ 0.12 to use the cooker for 15 minutes or deliver 90 kg of waste in exchange for using the cooker for an hour.

The cooker has reduced the use of wood leading to the protection of forests and also contributed to the improvement of the local environment in Kibera. The Community Cooker has since its commissioning won a myriad of awards including Environmental Impact Award from British Expertise, the World Design Impact Award and the Ingenuity Awards Urban Ideas in Action from the Financial Times.

Sustainability

The Community Cookers project is economically, environmentally and technologically sustainable. The services offered are affordable to the community and provides a source of income for the group that runs the facility. The community cooker has contributed to environmental conservation and improved the environment by reducing the mountains of rubbish that are a common sight in Kibera. The waste to be found on every other street and footpath was detrimental to the nearby Nairobi River. The inclusion of toilets and showers at the facility has served to improved sanitation. The community cooker hast reduces deforestation and the amount of money that its users spend on charcoal and firewood which are the main sources of fuel in the informal settlement. The construction of the cooker has saved the equivalent of several tonnes of charcoal and firewood. The project is designed to make use of locally available materials meaning that repairs, maintenance and operation can be easily carried out by members of the local community.

Lessons Learned

The Community Cooker has the potential to offer a solution for the challenges of waste management in Kibera while solving other related issues such as the financial and environmental costs of using charcoal and firewood. One of the main factors contributing to the success of the cooker is its socially inclusive vision for change achieved by engaging the local community to participate in collecting rubbish in exchange for energy to cook food, bake and heat water.

Transferability

The Community Cooker is a simple machine and can be built almost anywhere. Following the success of the Community Cooker in Kibera, two more cookers have been constructed in an informal settlement in Naivasha a town in Kenya's Rift Valley, and at a children's home in Kawangware another densely populated informal settlement in Nairobi.

ENERGY ACCESS: Clean Cooking Energy (12)

Title of Best Practice	Natural Gas Distribution for Low-income Families in Colombia
City/Town	Urban Centres in the Caribbean Coast and the South-west
Country	Colombia
Source	https://openknowledge.worldbank.org/bitstream/handle/10986/10945/548500BRI0OBAp10Box349431B01PUBLIC1.txt?sequence=2

Background

Despite the country having ample reserves of natural gas, the poorest segments of Colombian society do not have access to clean energy. More than half of Colombia's population lives below the poverty line with the Caribbean Coast and South-West regions containing some of the country's poorest households. Obtaining a new gas connection costs US$ 370 a considerable amount considering that in regions such as the Caribbean coast, average annual income is less than US$ 170.

Due to these high costs, poor households use polluting fuels like firewood and coal for heating and cooking. Natural gas connections offer a cleaner, more affordable alternative to meet these basic needs. The Natural Gas Distribution for Low Income Families program had the objective of providing 35,000 of the poorest households in urban centres along the Caribbean Coast and in the south-west regions of Colombia with natural gas service connections. The program was undertaken by Promigas Colombia's largest gas holding company. Financing was provided by the Global Partnership on Output-Based Aid (GPOBA). The program sought to subsidize the one-time connection cost for natural gas access including the installation of internal connections. The connections coupled with the distribution of gas stoves was meant to enable long term socio-economic benefits for low income communities.

Process and Innovation

The program started in 2006. Promigas with the assistance of GPOBA designed a program that would subsidize the cost of new connections to the natural gas grid. However, realizing that a connection subsidy was not enough, the project included the installation of a stove in each household. The poorest households were identified by the socio-economic classification system developed by Colombian authorities and verified by Promigas and GPOBA to ensure that the poorest households benefitted from the program. The media was used to publicize the program and engage with the disadvantaged communities.

Promigas' regional distribution companies implemented the program. GBOPA subsidized the connection costs paying US$ 141 for each new connection. The remaining amount of US$ 229 was paid by the households who received loans from the regional gas distribution companies. The loan was to be repaid over a period of 6 years. Promigas was responsible for coordinating the allocation of grant funds among the gas distribution companies and for consolidating and processing payment requests to GPOBA.

The program's main innovation was the use of GPOBA's output-based approach under which subsidies were only paid to the gas company once measurable outputs had been verified. The outputs included proof that each newly connected household belonged to one of Colombia's two poorest socio-economic strata as well as certification and inspection of the new connections.

Outcomes

34,139 new gas connections were made by the program from its commencement in 2006 up to 2008. Newly connected households benefitted from access to affordable, clean energy (pictured left). The switch from firewood and other biomass fuels to natural gas for cooking purposes enabled beneficiaries to make significant savings in household expenses. It also made cooking safer. The incidence of respiratory illness in the year after the program was implemented fell by 75% due to reduced exposure to harmful indoor air pollution.

The program resulted in an overall improvement of beneficiaries' standards of living while improving the health outcomes at the same time. Using natural gas to replace biomass fuels also led to the preservation of an estimated 34 hectares of forest and swamp land. The rate of default among the beneficiaries was reported to be less than 1%.

Sustainability

There is a direct link between health, poverty and access to clean and affordable energy. The program enabled more than 34,000 poor households to replace biomass fuels with natural gas as their main cooking fuel. Its environmental sustainability is directly linked to improvements in the beneficiaries' health outcomes. The burning of biomass fuels indoors leads to respiratory diseases and eye infections and the impact of indoor air pollution is particularly severe on women and children.

Lessons Learned

The replication of the program would depend on the design of a mechanism to target the poorest households. It also depends on the presence of a strong implementer able to ensure uptake of the connections. The program would also need to be implemented alongside an aggressive education campaign to "sell" the benefits of switching to cleaner fuels and to demonstrate the resultant actual savings.

According to a study conducted at the conclusion of the program, the reduction in exposure to indoor air pollution resulted in an estimated 4,000 disability- adjusted life years (DALYs). This suggests that the Natural Gas Distribution for Low Income Families in Colombia program and similar initiatives if successfully implemented can achieve health outcomes as cost-effectively as any health care intervention.

Transferability

Similar to the FVPS Gas project, the program can be successfully replicated in countries with vast reserves of natural gas.

ENERGY ACCESS: Clean Cooking Energy (13)

Title of Best Practice	TOTALGAZ LPG Distribution by Mobile Retail Dealers
City/Town	Dhaka, Chittagong, Rajshahi, Khulna, Barisal, Sylhet and Rangpur
Country	Bangladesh
Source	http://www.esmap.org/sites/esmap.org/files/FINAL_EA-Case%20Studies.pdf

Background
Like Argentina and Colombia, Bangladesh has abundant gas supplies. However, 90% of the country's population uses biomass for cooking. By 2005, only about 2 million households had been gas connections. Liquefied Petroleum Gas (LPG) consumption stood at 60,000 tons against a market capacity of 300,000 tons. The lack of access to quality cooking energy therefore constituted a major challenge for millions of Bangladeshi households.

The 1996 Energy Policy opened LPG marketing to private companies enabling firms like TOTALGAZ to distribute gas to households and businesses. TOTALGAZ started the Mobile Retail Dealers (MRDs) project in 2005 with the aim of increasing LPG use among urban households and small and medium size businesses without gas connections. Increasing access to LPG would reduce the deforestation that resulted from widespread use of traditional biomass for cooking.

Process and Innovation
Prior to the start of the project, TOTALGAZ conducted a market survey which found that there was a demand for home delivered LPG refill cylinders among households and small businesses like restaurants. The project started in Dhaka with training for the MRDs who work under the supervision of distributers selected by TOTALGAZ. The distributors provide MRDs with bicycles or rickshaws with which to deliver 12kg LPG cylinders. Customers can contact either the distributor or the MRD to order their gas cylinders. The MRDs are paid by commission depending on the volumes of LPG that they sell.

Previously, the main obstacles to LPG use were the lack of reliable supply as well as the inconvenience of collecting the cylinders from distributors who did not always have them in stock. These obstacles were removed by the MRD project. The project's main innovation was the distribution of free burners and regulators to first time customers enabling TOTALGAZ to secure new customers while increasing the number of LPG users in the process.

Outcomes
The project has successfully increased sales of LPG and reduced reliance on traditional biomass fuels. New jobs have been created and other companies have been forced to improve service provision to customers. MRDs can earn up to US$ 130 a month and households have been saved from the time-consuming exercise of collecting LPG refill cylinders from distributors' premises. Customers also made financial savings. The success of the project has seen it expanded to other urban areas of Bangladesh in Rajshahi, Khulna, Chittagong, Barisal, Sylhet and Rangpur.

Sustainability
The project is environmentally sustainable. In 2005, it won the Sustainable Development Award from Total Corporate headquarters. This was in recognition of the fact that the project had led to a substantial decrease in the use of traditional biomass for cooking curbing deforestation while reducing indoor air pollution. It is also operationally sustainable. With 150 distributors and at least 1,930 registered MRDs, the project has provided employment opportunities for previously

unemployed people enabling them to improve their livelihoods. Distributors have seen LPG sales volumes increase markedly.

Lessons Learned

The fact that the project was implemented by people who understood the LPG business contributed to its success. The distributors were aware of the local problems and challenges that would be faced by the MRDs and how these could be surmounted. TOTALGAZ's commitment to establishing itself as the leading LPG supplier in Bangladesh was also crucial to the success of the project. To achieve this, the company actively promoted the project, providing financial support to distributors and MRDs while also providing the overall planning and monitoring for project activities.

Transferability

Other companies have adopted the MRD approach used by TOTALGAZ in this project. The model has been successfully replicated in other cities in Bangladesh. Its main thrust which is the door to door delivery service can also be replicated in rural areas.

ENERGY ACCESS: Clean Cooking Energy (14)

Title of Best Practice	The Butanization Program
City/Town	Nationwide
Country	Senegal
Source	http://sei-us.org/Publications_PDF/SEI-ENDA-EnergyScenarioSenegal-93.pdf

Background

With a constantly increasing population, biomass fuels accounted for more than 60% of Senegal's total energy consumption in the early 1970s. The unsustainable use of firewood and charcoal was deemed detrimental to the country's forest and vegetation cover. Domestic use of these fuels was increasing most rapidly in Senegal's urban areas where the fastest population growth was occurring. In order to counter the decimation of Senegal's wood resources, the government instigated the Butanization program. The program's main objective was to bring about changes that would diversify household energy consumption.

In addition to contributing to high rates of deforestation, over-reliance on firewood and charcoal led to health problems associated with high levels of indoor air pollution. The Butanization program promoted the use of Liquefied Petroleum Gas (LPG) a clean cooking fuel in urban and peri-urban areas of the country.

Process and Innovation

The program followed an earlier, less successful attempt by the government to promote the use of LPG. Sales of an LPG-compatible stove exempt from import duty had failed to take off leading to the introduction in 1976 of the revamped Butanization program which offered a subsidy on 2.75 kg LPG cylinders. The subsidy was funded through taxes levied on other petroleum products and was later extended to include 6 kg cylinders (pictured left). As the main driver of the program the government also put in place parallel measures that would enable the management of the country's forest resources.

The program's innovations included the targeted promotion of the smaller units of LPG cylinders which were affordable for the poor, the use of cross-subsidies to support the program and the encouragement of competition among players in the sector. The latter ensured that the price of LPG would remain low even following the subsequent withdrawal of the subsidy that the program had put in place.

Outcomes

The Butanization program succeeded in making LPG the main household cooking fuel surpassing the use of firewood and charcoal. In 2006, LPG was the primary cooking fuel for 71% of urban households. In the capital Dakar, it was estimated that 90% of the population used LPG for cooking. There has also been a marked increase in annual domestic LPG consumption which rose from 3,000 tons in 1974 up to 140,000 tons in 2005. The 2.75 kg cylinders accounted for the majority of LPG sales.

Sustainability
Due to its geographical location, Senegal is susceptible to drought making it essential that the deforestation that was being caused by the use of biomass resources be reduced. According to Ministry of Energy estimates, the growth in LPG use has resulted in annual savings of about 70,000 tons of firewood and 90,000 tons of charcoal. The Butanization program has therefore succeeded in reducing the use of wood-based fuels and served to curb rampant deforestation highlighting its environmental sustainability.

The financial sustainability of the program was illustrated by the fact that even with the elimination of government subsidies in 2002, there has been no discernible reduction in LPG sales. In fact, sales of LPG continued to rise as it remained affordable among most urban and peri-urban households in Senegal.

Lessons Learned
The key lessons learned from the Butanization program include the importance of political will. The government's leadership and active participation in the program enabled the effective management of the LPG pricing structure allowing the rapid development of the market. The government's political will in ensuring the success of the project was also evidenced by the measures that were put in place to enable wood resource management. These measures included regulation of the exploitation and use of forest products through increases in wood cutting licence fees, tighter fuel wood production quotas as well as progressive increases in the official price of charcoal.

Transferability
Through the Butanization program, Senegal has had great success in integrating LPG into household cooking achieved mainly through the deployment of fuel subsidies. This approach has been adopted in various other African countries. An efficient means for replicating the success of the Butanization program involve the removal of the VAT that is charged on LPG.

ENERGY EFFICIENCY: Appropriate Technologies (15)

Title of Best Practice	Litre of Light
City/Town	Manila
Country	Philippines
Source	www.unfccc.int/secretariat/momentum_for_change/items/6638.php

Background

A common characteristic of households in informal settlements is the lack of ambient lighting during the day. Security concerns allied with nonexistent or typically small windows means that natural daylight cannot be used to provide lighting. Households that are connected to the grid cannot switch on their lights during the day because it would lead to higher electricity bills. The lighting of candles or kerosene lamps would have similar cost implications.

The *Isang Litrong Liwanang* (Litre of Light) project was instigated to provide a natural source of light that would illuminate dimly lit classrooms and enable poor households in Manila to complete everyday tasks using good quality lighting. The Litre of Light is a plastic bottle filled with water and a small amount of bleach. Designed and developed by students at the Massachusetts Institute of Technology, the device was disseminated in informal settlements in Manila under a project led by a local NGO known as MyShelter Foundation.

Process and Innovation

The project started in 2011. Most of the plastic bottles used are recycled, one litre bottles that lend the technology its name. After being filled with water and bleach, the bottle is pushed through a small piece of corrugated iron which serves as a metal lock to prevent it from slipping. It is then embedded into a corrugated iron roof. A small part of the bottle is left outside while the rest of it protrudes into the house (as pictured below). Sealant is put around the hole made in the roof to keep it weather proof.

The refractive properties of water ensures that the light from the sun that reaches the inside of the bottle becomes omni-directional mimicking an electric light bulb. The device emits the same amount of light as a 40-60 W incandescent bulb depending on the amount of solar insolation available. Adding bleach to the water prevents it from turning green with algae and ensures a high quality light by keeping the water clear.

The project's innovation lies in its utilization of cheap, durable and readily available materials to produce high quality natural lighting. This enabled urban poor households to have access to an affordable, environmentally friendly long-term alternative to electric light for use during the day.

Outcomes

The project installed about 10,000 of the litre of light devices in Manila and its environs. The households paid US$ 1 to have the light installed and ended up saving an average of US$ 6 per month that would have otherwise have been used to pay for electricity. The US$ 6 saved every month represents a substantial amount for households which live on incomes of less than a dollar day.

In addition to reducing the cost of energy for poor households, the project also had the effect of improving the quality of life for the beneficiary households and promoting the uptake of appropriate technologies in addressing the challenges faced by households in Manila's informal settlement.

Sustainability

The litre of light is an environmentally-friendly alternative to the daytime use of incandescent light bulbs and kerosene. The plastic bottles and the other materials used are easily available. Coupled with the simple assembly, this means that even people in the most deprived neighbourhoods can install the lighting units and enjoy the considerable benefits associated with access to better lighting. Once installed the bottle is estimated to continue producing light for a period of five years before having to be replaced. According to MyShelter Foundation, the GHG emissions savings accumulated from substituting an incandescent bulb with the litre of light and using it for the same number of hours during the day are substantial, especially when considered over the five year lifetime of the latter technology.

Lessons Learned

The simplicity and effectiveness of the technology were major factors in spurring the overwhelming acceptance of the device by beneficiaries. The cost savings that the beneficiaries accrued from the installation of the technology also made it attractive to Manila's urban poor households.

Transferability

The project is easily transferable. People in other cities faced with similar challenges to the urban poor in Manila have assembled and installed the technology. Instructions on installation are available from dedicated website **www.ALiterOfLight** and social media outlets including Facebook. UN-Habitat is working with local NGOs in Kenya and Cameroon to have the devices installed in households in informal settlements in Nairobi and in Douala and Yaoundé.

ENERGY EFFICIENCY: Home Retrofitting (16)

Title of Best Practice	The Kuyasa Clean Development Mechanism Project
City/Town	Kuyasa, Cape Town
Country	South Africa
Source	www.esmap.org/sites/esmap.org/files/Kuyasa_EECI_Housing_FinalCaseStudy_Africa.pdf www.cleanenergyawards.com/top-navigation/nominees-projects/nominee-detail/project/28/?cHash=55d90c3619

Background

Kuyasa is a low income community within a township settlement called Khayelitsha in Cape Town. The Kuyasa Clean Development Mechanism (CDM) project was undertaken by the City of Cape Town in partnership with South South North (SSN). The houses targeted by the project already had electricity but were poorly designed and typically had no ceiling or roof insulation. Incandescent lamps were used for lighting and hot water was mainly heated using electric, paraffin or gas stoves which all added substantially to the households' energy consumption and costs.

The project's objective was to retrofit 2,300 houses with thermal insulated ceilings, solar water heaters, energy efficient Compact Fluorescent Lamps (CFLs) and wiring improvements. Some houses also received 'hotboxes' which are thermal insulation cooking devices used to help to reduce the cost of cooking by keeping foodstuffs at a constant temperature.

Process and Innovation

The pilot phase of the project commenced in 2002 with the retrofitting of 10 houses. The successful implementation of the pilot phase led to more houses in Kuyasa being included in the exercise and the project's registration as a CDM project with UNFCCC in 2005. Local contractors were selected through an open tender to undertake the energy efficiency retrofitting work. Community participation was facilitated and mobilised through information and capacity building workshops. Under the project's skills development component, unemployed residents received training in carpentry, plumbing and electrical wiring and installation participated in the home retrofitting exercise (pictured left).

The thermal performance of the retrofitted houses was monitored constantly to record any improvements realized as a result of the project.

The project's main challenge at the beginning was obtaining the financing to cover the capital costs of deploying the technologies. This was overcome through negotiations which ultimately led to a financing solution that included grants and loans provided by stakeholders interested in promoting energy efficiency among low income populations. The financing mechanism was one of the project's main innovations. It was also South Africa's first CDM project activity. The reduction of GHG made the project eligible to receive Certified Emission Reduction (CER) income based on the avoided pollutant emissions.

Outcomes

The project ended in 2010 with the retrofitting of a total of 2,309 houses having been successfully completed. It led to improved energy efficiency for the beneficiary households as well as cost savings.

The project created employment opportunities for locals who were involved in project implementation. Health wise, the project successfully reduced the need for kerosene stoves and other heat sources which are responsible for respiratory illnesses and also pose significant fire risks. Because the houses are warmer as a result of the installation of insulated ceilings, the incidence of illnesses like flu associated with exposure to cold weather during the winter months has dropped significantly.

According to a report by ESMAP's Energy Efficient Cities Initiative, the Kuyasa Clean Development Mechanism project has led to substantial annual savings of carbon dioxide emissions which will be realized over the project's stipulated lifespan as a CDM project.

Sustainability

The project has received international recognition through its validation as a Gold Standard CDM project. The award is given to projects that contribute to sustainable development. The project successfully demonstrated the potential of energy efficiency and clean energy to contribute to environmental benefits associated with the reduction of emission and local air pollution. Household energy demand and consumption were reduced resulting in a corresponding reduction in energy expenditure. The CER income generated from emissions savings over the project's crediting period is used to meet costs including loan repayments to financiers, maintenance and CDM monitoring costs.

The project contributed to the reduction of energy poverty while demonstrating how energy efficiency initiatives in low income communities can be successfully implemented with positive results in the alleviation of complex interrelated problems such as income poverty, unemployment and environmental sustainability.

Lessons Learned

The monitoring and evaluation of the practical performance of the project technologies during the pilot phase provided both first hand and anecdotal evidence of the benefits of the energy efficient housing units. SSN was able to use this information to leverage financial grants and loans to meet the capital costs of the project from stakeholders who shared the common interest of seeing the implementation of energy efficiency projects that benefitted poor households. The monitoring and evaluation also ended up being useful in helping city authorities compile the data required for CDM registration.

Transferability

In addition to the Gold Standard Award, the project has also won an award from the Vienna-based Renewable Energy and Energy Efficiency Partnership which called it a model project for national replication. Developing countries have millions of low income households that would benefit from similar initiatives. In South Africa, its replication would assist municipalities in their quest to achieve energy efficiency and renewable energy targets.

ENERGY EFFICIENCY: Eco-Housing (17)

Title of Best Practice	Kutlwanong Eco-Housing Pilot Project
City/Town	Kutlwanong, Community, Galeshewe Township, Kimberley
Country	South Africa
Source	http://energy4africa.net/klunne/publications/Klunne_eeh_SA_overview.pdf

Background

In 1995, Kutlwanong was an informal settlement with a population of 8,000 residents within the city of Kimberley. Kutlwanong was characterized by informal dwellings, limited basic services, high rates of unemployment and congestion. Members of the local community sought to have access to electricity and jobs and to have their shelters upgraded to modern brick housing units. This created an opportunity for experimentation with the then relatively new concept of eco-housing known as Energy, Environmental, Empowerment- Cost Optimised (EEECO™) housing that had been developed by PEER Africa.

PEER Africa and the Kutlwanong community devised the Kutlwanong EEECO™ housing project which had as its central thrust the combining of energy efficiency, job creation and local research with the development and demonstration of eco-housing. The project was undertaken in line with the South African government's objective of addressing the housing shortfall for the poorest 1.5 million households. PEER Africa provided technical support for the project. USAID, the United States Department of Energy, the Northern Cape Provincial Housing Department, the South African Department of Minerals and Energy and members of the local community through the Kutlwanong Civic Integrated Housing Trust (KCIHT), IIEC, ESKOM the largest electricity utility in South Africa, the University of Witwatersrand and the US Clean Coal Technology Centre were also involved in the delivery of the project.

Process and Innovation

After a number of preplanning and introductory workshops hosted by PEER Africa in the community, KCIHT was formed to manage project delivery. To keep costs low, the project incorporated "sweat equity" with the community providing construction labour for salaries below the market rate. More than 200 community members, 10% of them women were trained and employed as builders on the project receiving on-the-job skills training.

The project held sessions to raise awareness of low-cost, environmentally sound, energy efficient housing. The first housing units built by the project were to be part of a pilot scheme showcasing energy efficient housing as compared to business as usual government sponsored housing. The new units would integrate passive solar design techniques, safe cooking and space heating interventions.

Some of the eco-housing units were built were based on an insulated brick cavity wall system. The remaining units incorporated the use of a steel frame as the basic structure and polystyrene, a widely used insulant as the primary insulating material to prevent heat loss in winter and heat gain in summer. Other design features common to all the houses included northern orientation, window sizing to maximize thermal benefit in winter, roof overhang to shade windows during the summer and insulated ceilings. To reduce reliance on unsafe coal and traditional biomass, solar stoves and prototype kerosene stoves were introduced as part of the pilot project. Compact Fluorescent Lamps (CFLs) were also promoted as replacements for inefficient incandescent light bulbs.

The project's main innovation was the incorporation of environmental and energy efficiency awareness into the planning, development and implementation process and the design of EEECO™ houses. The project also ensured that while the design and construction of the houses were fairly sophisticated, all the materials used were easily available in South Africa.

Outcomes

A demonstration house was the first to be completed. This was followed by an additional 200 units.

In 1999, the houses saved an estimated 210 metric tons of carbon dioxide. The units not only improved thermal performance and reduced energy consumption but also helped improve indoor air quality. The housing units were constructed from materials that do not readily burn reducing the risk of fires that are prevalent in informal settlements. Thermal comfort and energy efficiency evaluations conducted showed that the EEECO™ houses consistently out-performed government subsidy houses.

Sustainability

The project was notable for its emphasis on self-help housing construction and the efficiency of resource usage which successfully lowered energy demand. This substantially reduced carbon dioxide emissions highlighting the project's environmental sustainability credentials. The project was also aligned with the South African government's immediate development needs and linked those priorities to sustainable human settlement with the promotion of health and safety in low cost housing. It successfully addressed the challenges of indoor air quality and fires through the provision of energy efficient and environmentally sustainable and affordable housing. The project is also operationally sustainable. KCHIT formed at the start of the project remains a going concern involved in renewable energy training and energy efficiency promotion campaigns.

Lessons Learned

Having the support and championship of the government was an important factor in the success of the project. The South African and the United States governments' bi-national agreement gave the project top down credibility leading to the easing of some of the bureaucracy that would otherwise have hampered its delivery. Understanding the community's exact needs and the encouragement of their active participation by PEER Africa and KCHIT were also important ingredients as was aligning the project to the country's developmental needs which highlighted a focus on new housing units to meet ever-growing demand. The latter ensured that all the partners and other external stakeholders responded positively to the project.

Transferability

The project's environmental and energy concerns were based on the general livelihood conditions in South Africa. These conditions apply to other developing countries with inequities in housing standards, high rates of unemployment and significant energy shortfalls. The project has been replicated in the implementation of other initiatives most notably the Gugulethu Tambo Village project and the Witsand EEECO™ Human Settlement program also in Cape Town. The EEECO™ concept has been lauded as a highly successful development methodology by world leaders and in April 2012, GEF hosted a workshop to discuss EEECO™ rollout in other developing countries.

ENERGY EFFICIENCY: Street Light Retrofitting (18)

Title of Best Practice	Energy Efficient Street Lighting
City/Town	Akola
Country	India
Source	http://www.esmap.org/sites/esmap.org/files/CS_India_SL_Akola_020910.pdf

Background
Street lighting accounts for an estimated 20-30% of electricity consumption by any municipal council. Only water supply accounts for higher energy consumption in the municipal setting. Street lighting systems run by municipalities are often inefficient due to the widespread use of low cost inefficient lamp technology, poor design and installation and poor operation and maintenance practices.

Akola is a city with a population of 450,000 located in the Indian state of Maharashtra. Rising bills for street lighting and the other local government services including sewage pumping, lighting in public buildings and water supply constituted a major challenge for Akola Municipal Corporation. The municipality initiated the Energy Efficient Street Lighting Project in 2006 with the aim of improving street lighting while lowering the attendant costs and electricity bills. The project was undertaken in partnership with Asia Electronics Limited (AEL) which was responsible for financing all the initial investment costs, implementing the project and maintaining the newly installed street lights.

Process and Innovation
The project had commenced with the Akola Municipal Corporation issuing a call for competitive bids from energy service companies. AEL which had been involved in the implementation of other energy efficient street lighting projects in India was selected at the end of the bidding process. Under the terms of the contract, AEL was contracted to replace the city's entire stock of old technology street lamps with energy efficient T-5 fluorescent tube lamps. The retrofitting exercise started in April 2007 and lasted a period of 3 months during which AEL also installed new street light accessories including electronic ballasts, programmable timer switches and power saver units. AEL and Akola Municipal Corporation were both responsible for monitoring the savings realized as a result of the installation of the new street lighting equipment.

The Energy Efficient Street Lighting project's principal innovation was the use of an energy savings performance contract under which the city did not need to pay the project costs upfront. Instead, AEL financed all the investment costs. The terms of the contract stipulated that the company would receive payment equivalent to 95% of the energy bill savings over a period of six years. AEL was also charged with replacing failed lamps and fixtures for which was to be paid a fixed annual fee.

Outcomes
The project successfully achieved its aim of improving street lighting services while lowering energy consumption and costs. Prior to the implementation of the project, not all existing street lamps were working. The project installed fully functional lamps along the city's streets. The municipality's annual electricity bill was reduced by more than 2 million kWh which translates into monetary savings of US$ 133,000. Accompanying GHG emissions annual reductions equalled 1,830 tons of carbon dioxide. An additional benefit for Akola Municipal Corporation stemming from the terms of the energy savings performance contract has been the freeing up of municipality staff from duties

associated with maintaining old technology lamps used for street lighting. As a result of the project, they were able to attend to other public priorities.

Sustainability

The project is both financially and operationally sustainable. Akola Municipal Corporation did not pay any upfront costs for the delivery of the project. However, the municipality will receive money from the project to the tune of 5% of energy savings over the duration of its contract with the energy service company. For AEL, the project represented an attractive, cost effective investment. That AEL was able to recover its financial outlay inside eleven months should act as an incentive for energy service companies undertaking similar initiatives. The project also proved to be environmentally sustainable resulting in the avoidance of a total of 10,980 metric tons of carbon dioxide emissions over the contract period.

Lessons Learned

The leadership provided by Akola Municipal Corporation officials in taking the initiative to design and implement the energy savings performance contract was essential for the success of the project. The processes and tools that were utilized including the tender and final contract can be of immense value to other municipalities which seek to lower energy costs but find themselves faced with the challenges associated with inefficient street lighting equipment, high maintenance costs, low service levels and restricted budgetary resources for equipment upgrading.

Transferability

There is tremendous potential for municipalities to improve the quality of street lighting while reducing energy use, the associated costs and GHG emissions through the implementation of energy-efficient retrofits for street lighting. The Akola project's success has already led to similar projects based on energy savings performance contracts being implemented in other Indian states.

ENERGY EFFICIENCY: Energy Efficient Lighting (19)

Title of Best Practice	Rwanda Electrogaz CFL Distribution Project
City/Town	National
Country	Rwanda
Source	https://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=48074

Background

Less than 10% of Rwanda's population is connected to the grid. The country plans to increase the number of households connected to the grid to 70% by 2020. However, plans to expand residential sector access to electricity will have to be accompanied by measures to reduce electricity consumption. Under the Rwanda Electrogaz CFL Distribution project, existing grid-connected customers had the opportunity to exchange incandescent lamps for high quality Compact Fluorescent Lamps (CFLs) which at the time constituted a negligible portion of the market for lighting devices.

The project was undertaken by Electrogaz the power utility and the International Bank for Reconstruction and Development. The bank acted as trustee for the Community Development Carbon Fund (CDCF). CDCF provides carbon finance to projects in poor areas of the developing world supporting efforts that combine community development with emission reductions to improve the lives of the poor and their local environment. Electrogaz has since been renamed the Energy Water and Sanitation Authority.

Prior to the project, poor households connected to the grid mainly used inefficient incandescent lamps rated between 40W and 100W. This led to high levels of electricity consumption reflected in high electricity bills. The project aimed to enable the poorest households to afford access to electricity on a more sustainable basis.

Process and Innovation

The pilot phase of the project was carried out from July to September 2007. 500,000 CFLs were distributed free of charge with each customer receiving two lamps in exchange for each 100W incandescent bulb. The success of the pilot saw the project expanded to include second, third and fourth phases. Under the second phase, 150,000 CFLs were distributed. Customers bought five lamps at discounted rates in exchange for five incandescent bulbs rated between 60W and 100W. The third phase of the project saw a further 200,000 CFLs exchanged for incandescent bulbs with customers again purchasing CFL units at discounted prices. During the project's fourth phase, an additional 400,000 CFLs were distributed to customers. There were no exchanges with incandescent bulbs in this final phase but customers purchased CFLs at prices that were set below the market rate.

Awareness-raising campaigns were also conducted including advertising (pictured above left) to educate the utility's subscribers on the benefits of using CFLs. The project's main challenge stemmed from the relatively high cost of CFLs. Before the project began, incandescent lamps were sold for about US$ 0.4 while CFLs cost as much as US$ 7. In order for the project to succeed, the cost of CFLs had to be subsidized to make them affordable to the households. The Energy Water and

Sanitation Authority purchased CFLs in bulk negotiating a significantly reduced price. This enabled the utility to distribute CFL units at rates below the market price.

Outcomes

A survey conducted on a sample of households following the pilot project showed increased awareness and interest in CFLs. Subsequent phases of the project saw the distribution of 750,000 more CFLs. The lamps were each sold for US$ 0.4 making them affordable for low income households. By replacing inefficient incandescent technology with CFLs, the project had the effect of reducing households' electricity bills. It led to a reduction in the electricity consumption thus impacting positively on the environment.

Sustainability

The project led to significant reductions in peak demand for grid electricity allowing the utility to increase its consumer base and provide access to previously unelectrified households. It also contributed to lower electricity bills for end-users as CFLs are up to 75% more efficient than incandescent lamps. Low income households received education on energy efficiency which had the effect of reducing the carbon emissions. The annual emissions reductions resulting from the project was estimated at 16,020 tons of carbon dioxide in 2009. By 2016, the project will have reduced emissions by 72,954 tons underlining its environmental sustainability.

Lessons Learned

The main barrier to the uptake of CFLs is the high retail cost of good quality CFLs compared to incandescent lamps. Prior to the project, CFLs cost almost 18 times more than incandescent lamps. This made them unaffordable for low income households despite the lifecycle electricity bill savings that can be realized through the use of energy efficient lighting. The project illustrated that low income households are willing to purchase fairly priced, high quality CFLs once they are aware of the advantages of the technology.

Transferability

The exchange of incandescent lamps for high efficiency lighting systems for use in the residential sector has proven to be an effective demand side management measure. CFL promotion projects have been undertaken in other countries in the East African region where electricity demand surpasses supply. The Efficient Lighting Initiative (ELI) funded by GEF also focused on the replacement of incandescent lamps with CFLs. ELI was undertaken in cities in seven countries including Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines and South Africa.

ENERGY EFFICIENCY: Energy Efficient Lighting (20)

Title of Best Practice	BESCOM Efficient Lighting Program
City/Town	Bangalore
Country	India
Source	http://www.esmap.org/sites/esmap.org/files/10.%20BELP_Program_Note.pdf

Background

The Indian city of Bangalore has a population of about 8.5 million. Bangalore is a major economic and cultural hub and the second fastest growing metropolis in India. Bangalore has more than 860 informal settlements which are home to an estimated 20% of the city's residents. Inefficient use of electricity is a common occurrence and is reflected in the high levels of household expenditure on electricity bills.

The Bangalore Electricity Supply Company (BESCOM) is a distribution utility in the state of Karnataka with a customer base of 4 million. The utility launched the BESCOM Efficient Lighting Program (BELP) in 2004. The program was implemented in partnership with the International Institute for Energy Conservation (IIEC). BELP replaced inefficient incandescent bulbs with Compact Fluorescent Lamps (CFLs) with the aim of developing a market-based mechanism to promote the use of CFLs and to provide financial savings to BESCOM's domestic and small business customers. It also aimed to achieve system benefits including peak demand reduction and improvement in load factor and power quality. Funding for the BELP was provided by USAID.

Process and Innovation

BESCOM and IIEC conducted several meetings with stakeholders including lighting manufacturers, suppliers and retailers and formally issued an invitation for bids. 3 companies, namely Philips, Osram and Asian Electronics were selected to participate in BELP. In addition to advertising and promotion, BESCOM conducted awareness-raising through its customer support centres which distributed leaflets, posters and other program promotional material.

Customers bought CFLs from approved retailers (pictured left) and completed a sales voucher that confirmed the purchase. BELP used branding which allowed customers to select outlets that sold CFLs made by the suppliers included in the program. A 12 month warranty was offered on the lamps. Compared to the market price, the cost of CFLs to customers was reduced by 15% under BELP.

The program's main innovation was that low income customers were allowed to pay for the CFLs in 9 instalments recovered through BESCOM monthly bills. Another important innovation concerned the use of Residents' Welfare Associations to promote the project to a wider base of Bangalore consumers.

Outcomes

The results of program monitoring carried out by IIEC showed that from December 2004 and October 2005, 175,000 more CFLs were sold compared to the same period during the previous year. About 80% of these customers were first-time buyers of CFLs. Billing analysis from the project

monitoring showed a reduction in household electricity bills. The monitoring showed that each conventional bulb replaced by a CFL represented a monthly saving of US$ 0.34 for the customer.

BESCOM also benefitted from the program. Domestic sector customers contribute substantially to the system peak load especially in the evenings. The use of energy efficient lighting has contributed to the reduction of system peak demand as well as improvements in system load factor, power quality and customer relations. The increase in CFL sales recorded during the monitoring translates to a reduction in demand of 11.3 MW.

Sustainability

BELP sought to develop a sustainable model for a market-driven demand side management program to benefit the utility and its customers. Customers benefited from energy savings and reduced bills while BESCOM successfully realized its objectives of peak load reduction, reduced capital needs and reduced cost of supplying electricity. BELP had a positive impact on the environment with reduction in local pollution and GHG emissions.

The program also proved to be financially and operationally sustainable. BELP's market–based approach does not impose the burden of procurement and distribution on the sponsoring utility or any government agencies. Programs like BELP enhance energy security by freeing up extra generation capacity. The prices of CFLs have reduced even among retailers who did not participate in BELP. The warranty period for lamps has also increased as a result of the program.

Lessons Learned

The lessons learned in the implementation of BELP include the need for customer education on wattage comparison and the energy savings that can be accrued from the use of energy efficient lighting. Another lesson concerned the importance of utility endorsement and branding which can boost consumer confidence. This is especially important as the presence of poor quality CFLs in the market can erode consumer confidence and damage the credibility of the technology.

Transferability

Properly designed CFL programs can have substantial beneficial effects resulting from increased customer awareness. BELP was the first large-scale attempt at promoting efficient lighting in the domestic sector in India. As a result of the project's success, other utilities in India including Tata Power in Mumbai have approached BESCOM and IIEC for assistance in developing similar initiatives. BESCOM and IIEC have also expanded their own program from the initial target area which was limited to urban Bangalore to cover other areas that fall under the utility's service territory.

ENERGY EFFICIENCY: Awareness Raising (21)

Title of Best Practice	Community Energy Initiatives
City/Town	Arusha
Country	Tanzania
Source	www.sylff.org/pdf/fellows/JIP2007_NairobiBerkeley.pdf www.tokyofoundation.org/en/topics/sylff/daily-life-in-tanzania-improved-by-jip-promotion

Background

The city of Arusha in North-Eastern Tanzania has a population of 500,000. About 70% of the population lives in informal settlements on the outskirts of the city. According to UN-Habitat, Arusha has an annual population growth rate of 5% and an unemployment rate estimated at 60%. The city's poor households cannot afford the investments needed to access modern energy and rely instead on firewood and charcoal for cooking and kerosene for lighting.

The Community Energy Initiatives project was implemented in the Sokoni One-Sombetini neighborhood of Arusha. Its objectives included the building of a Community Resource Center where community members could learn about energy saving technologies and alternative fuels to substitute firewood and charcoal use. The project aimed to increase the use of energy saving appliances, enhance income generation and leadership skills among local women and decrease the share of household budgets spent on energy. It also aimed to promote environmental preservation by decreasing the consumption of biomass resources.

The project was implemented by Women Development for Science and Technology Association (WODSTA) and a team drawn from the University of California Berkeley, the University of Nairobi, Cornell University, Princeton University and Universidad de Deusto in Spain. The Tokyo Foundation's Joint Initiative Program (JIP) provided the finance for the project.

Process and Innovation

The project was implemented following a study conducted by WODSTA which showed that on average, poor households in Northern Tanzania spend between 20% and 30% of their budget on biomass fuels and kerosene. It commenced with community-wide demonstrations and training aimed at increasing awareness of energy-saving technologies and fuels. These were focussed on the use of biofuels for cooking and lighting, the construction of solar water heaters, briquette presses, improved cook stoves and fuel-less insulated cooking baskets. Training on the production of briquettes and solar dryers for fruits and vegetables was also provided. A Community Energy Resource Centre was built to house the various technologies and act as a focal point for trainings and demonstrations of the alternative energies. Community members are able to visit the centre to purchase equipment or to learn about the energy saving technologies.

The project's innovation lies in the fact that it was developed following deep consultations with the community. Many of the ideas that went into its design came from the residents of Sokoni One-Sombetini. The Center is operated by women who also run the training programs. This was intended to increase awareness of gender equality among the community. Another innovation derives from the project's links with regional technology experts. These linkages have increased the center's credibility among the community.

Outcomes

The Community Energy Resource Centre has successfully acted as the focal point for energy efficiency and renewable energy technologies. Improved cook stoves, fuel-less cooking baskets and cooking fuels like briquettes and plant oil used for cooking and lighting are available for purchase by the community. Solar dryers and solar PV and biogas systems can also be purchased at the centre.

The project had begun with a baseline survey that measured energy usage and community awareness and acceptance of energy-saving technology. Another survey conducted at the end of project among Sokoni One-Sombetini who had purchased fuels and energy equipment from the center showed significant reductions in household expenditure and time spent cooking and collecting fuel. The average daily savings by families using improved cook stoves and briquettes amounted to US$ 0.25. This is a substantial amount in a country where the mean income is US$ 2 per day. The number of respondents aware of energy saving technologies had risen from 11% to an impressive 98%.

Other tangible project outcomes included an increase in income generation opportunities for women and improved environmental protection brought about by increased use of energy efficient appliances.

Sustainability

The Community Energy Resource Centre has become a place where low income families can purchase affordable, clean, and efficient technologies. It improved both the health of the women who are responsible for cooking and the local and regional environments. Women and girls no longer face the drudgery involved in collecting firewood. They also do not have to cook in smoke-filled kitchens with the ever-present dangers posed by indoor air pollution. The localization of clean-technology production has had a positive impact on the environment by reducing deforestation. The project also held training sessions to build the women's business skills. This ensured that all the appliances and fuels produced and sold at the centre generated a profit which could sustain it even when JIP and WODSTA ended their participation in the project.

Lessons Learned

Having a good understanding of Tanzanian culture contributed to the success of the project. In traditional Tanzanian society, men control household budgets and are responsible for making the important financial decisions. To enable women to participate and benefit from the project, the awareness raising and sensitization exercises also had to be targeted at men. This convinced them of the financial and environmental benefits of switching to energy efficient technologies. It also ensured that the entire community had ownership of the project with vested interest in its success.

Transferability

This project has shown that the concept of an Energy Resource Centre run by members of the community for their own benefit has tremendous potential and does not require much in terms of financial capital to set up. It can therefore be successfully replicated in other low income neighbourhoods.

ENERGY EFFICIENCY: Sustainable Charcoal Use (22)

Title of Best Practice	Developing Energy Enterprises Program: Promoting the Use of Biomass Briquettes
City/Town	Kampala
Country	Uganda
Source	www.gvepinternational.org/sites/default/files/briquette_businesses_in_uganda.pdf

Background

According to the Uganda National Bureau of Statistics, 76% of households in Kampala use charcoal as their main source of cooking fuel. Annual demand for charcoal was estimated at 205,852 tons. Demand for charcoal is expected to rise at an annual rate of 6% in line with the city's rate of urbanization leading to massive deforestation. The UN's Food and Agriculture Organization (FAO) reported that between 1990 and 2005, Uganda lost around 26% of its forest cover. This included 78% of forest cover around Kampala.

The Global Village Energy Partnership International (GVEP) is an international non-profit organization that works to increase access to modern energy in developing countries. GVEP does this by providing support services to micro enterprises and small and medium sized enterprises (SMEs) in the energy sector. Through the Developing Energy Enterprises Program (DEEP), GVEP sought to reduce the two interconnected challenges of energy poverty and income poverty by strengthening the private sector's ability to offer relevant products and services in East Africa. Biomass briquettes were identified as a viable substitute for charcoal use. Biomass briquettes are a form of solid fuel made by mixing organic material with a binder such as clay or starch. The dust left behind by charcoal dealers is the most common raw material used. Agricultural residues such as husks, cobs, cotton seed hulls, grass and leaves, sawdust and some Municipal Solid Waste (MSW) can also be used to produce briquettes.

Process and Innovation

DEEP started in 2008 and ended in early 2013. It was undertaken with funding from the EU and the Dutch Ministry for Foreign Affairs. The program provided energy sector micro enterprises with training and mentoring and also facilitated links to financing. 139 briquette making enterprises benefited from DEEP. A majority of these enterprises were located in Central Uganda and Kampala and were already familiar with briquette production before joining the program.

DEEP's main innovation lay in helping the enterprises create viable businesses out of briquette production. This was achieved through training in basic business skills, improving the quality of the briquettes and teaching the producers how to market their products effectively. The majority of the DEEP enterprises are owned by women. In Uganda, women are generally more involved businesses that require little capital to start-up and deal in products that can be sold to customers close by.

Outcomes

As wood resources are depleted, the price of charcoal rises. In December 2011, a kilogram of charcoal cost US$ 0.60 in Kampala. For poor households in the city, the availability of briquettes which were priced at between US$ 0.20 and US$ 0.40 a kilogram provided users with an opportunity to make substantial financial savings. The briquette industry has provided new employment opportunities. In September 2011, DEEP briquette enterprises in Kampala employed an average of 2 employees each.

Many of the entrepreneurs supported by DEEP remained small and continued to produce briquettes as a source of additional revenue. However, under the program a number of businesses also grew substantially, mechanized their production and hired additional workers.

Sustainability

The program was environmentally sustainable. The traditional methods of charcoal production used in Uganda are characterized by high inefficiency and current levels of charcoal use are not sustainable. Briquettes made with waste organic material can substitute charcoal use. Volumes of available raw material are insufficient to allow briquettes to fully replace charcoal. But at the current levels of production, briquette makers in Uganda use only a tiny fraction of the available material meaning that there is considerable scope for growth. Data from the Ministry of Energy and Mineral Development shows that the country generates 590,000 tons of bagasse, 234,000 tons of maize cobs and 160,000 tons of coffee husks as agricultural residues annually. This is in addition to 85,000 tons of rice husks and hulls and 50,000 tons of cotton seed hulls. Significant quantities of other agricultural residues that can be used to produce briquettes are also generated along with the 548,000 tons of MSW produced in Kampala.

Lessons Learned

Briquettes made by businesses supported by GVEP were of better quality and therefore more acceptable to consumers. The program demonstrated that with appropriate support, it is possible to transform micro businesses into small and even medium size businesses producing briquettes in reasonable volumes. Similar interventions should target entrepreneurs with the potential to grow into small and medium sized businesses and should be designed to help them achieve that transition.

In order to successfully produce high quality briquettes commercially and at a scale for the industry to significantly impact the fuel market, producers need to have access to appropriate equipment. GVEP identified a lack of adequate equipment as the biggest challenge faced by briquette producers surveyed during the course of DEEP. The quality of briquettes varied from one entrepreneur to the next due to the different methods used in production as well as the lack of quality control mechanisms. Addressing the inconsistency in the performance and quality and the volume of production is essential if biomass briquettes are to become more widely used.

Transferability

The program is highly transferable as briquettes can be produced on a small scale with very little capital using easily available raw materials. However, in order to replicate DEEP's successes, the price of the briquettes produced by similar initiatives must be competitive to ensure market penetration.

ENERGY EFFICIENCY: Improved Cook Stoves (23)

Title of Best Practice	Commercialization of Improved Cook Stoves for Reduced Indoor Air Pollution in North-western Bangladesh
City/Town	Saidpur and Parbatipur
Country	Bangladesh
Source	http://pdf.usaid.gov/pdf_docs/pnado851.pdf

Background

An estimated 90% of Bangladeshi households use biomass sources such as cow dung, leaves, twigs, straw, jute sticks, bamboo and wood for cooking. Lack of proper ventilation in informal settlements leads to heavy concentrations of smoke and fumes which endanger the health of all those who are exposed to it. In many parts of Bangladesh, the local biomass supply is inadequate and extremely poor families are occasionally forced to burn plastic and rubber materials as cooking fuel exposing them to even more dangerous and toxic pollution.

In order to address both the health and energy problems associated with household cooking practices, USAID appointed Winrock International to design and implement a pilot project to distribute improved cook stoves (ICS) in Bangladesh. Local organizations Concern Worldwide Bangladesh and the Village Education Resource Centre (VERC) were also involved as project implementation partners. The project ran from 2005 to 2007 in Saidpur and Parbatipur municipalities in the North-Western part of the country. The objectives of the project were to reduce indoor air pollution and fuel consumption via the dissemination and commercialization of ICS among peri-urban communities through an integrated energy intervention. The project also aimed to establish a sustainable market for ICS to avoid the need for future subsidies.

Process and Innovation

Many of the informal settlement households did not understand the extent of the damage to their health caused by indoor air pollution despite the obvious discomfort they felt during the long hours they spent in smoky kitchens. Concern Worldwide worked to raise awareness of the adverse effects of indoor air pollution and to promote behaviour change with regard to health and kitchen hygiene practices. This was done by designing and disseminating messages using drama, film shows and printed leaflets and billboards. The project conducted a baseline household survey which also measured indoor air pollution. The information gathered from the survey was used to inform the design of the new ICS units which were made with the onus placed on adaptation to the local biomass demand and supply realities.

Several ICS models were tested in labs and under field conditions. Local preference and ability to achieve the primary objective of reducing indoor air pollution, reducing fuel consumption and affordability were the main parameters considered. Three models were selected at the end of the testing process. VERC was in charge of disseminating the ICS, training entrepreneurs who would take over the sales of the stoves and managing the micro-credit funding offered to the entrepreneurs by the project to purchase ICS units. Project innovations included the encouragement of community participation in the process of identifying and selecting the appropriate ICS thus giving them a sense of ownership. The indigenous designs of the ICS also served to make the new models more acceptable to the community.

Outcomes

All three ICS models selected by the project were significantly less polluting than traditional stoves. Major reductions were recorded in particulate matter and carbon monoxide pollution accompanied by substantial increases in thermal efficiency. Tests showed a clear reduction in cooking time and fuel consumption. The project thus accomplished its objectives of reducing indoor air pollution and fuel consumption.

By the end of the project period, 583 households owned ICS. Indoor air pollution-related awareness-raising messages had been disseminated to over 50,000 people and increased commitment had been secured from the local governments to mitigate indoor air pollution. More than 25 cook stove entrepreneurships had also been established or supported by the project.

Feedback from project volunteers and the entrepreneurs charged with selling the ICS showed that in addition to the target group, the wider informal settlement community became aware of the health problems caused by indoor air pollution.

Sustainability

The project's operational and environmental sustainability as well as its success were anchored on product promotion with a communication campaign to raise awareness about the risks of indoor smoke. The project expounded the benefits of behaviour change and the use of ICS to reduce exposure to indoor air pollution. Implementers worked with existing local government institutions and health networks to disseminate behaviour change messages to ensure that even when project activities ended, the beneficiaries remained aware of the benefits of using ICS. The project teamed up with local entrepreneurs to disseminate stoves commercially. Incorporating the marketability of the ICS ensured both the financial and economic sustainability of the project. The project therefore succeeded in establishing a sustainable unsubsidized ICS market. The entrepreneurships established or supported by the project continued ICS dissemination well beyond the end of the project period.

Lessons Learned

Previous projects disseminating ICS in Bangladesh were not wholly successful as they were undertaken without sufficient emphasis placed on instigating behavioural change amongst beneficiaries. Winrock International's project on the other hand succeeded because it focussed on integrating the behavioural adjustment of the users and on the profitable marketing of ICS. Another important lesson learned concerned the importance of using local themes, human resources, skills, ideas, culture and ingredients which proved vital to the success of the project.

Transferability

Even after the project had ended, ICS sales continued to grow steadily with people living outside the areas it targeted also purchasing the stoves. It has been replicated by VERC in other Bangladeshi cities like Rajshahi, Chittagong, Savar, and Lalmohan. The project successfully illustrated the potential of initiatives disseminating ICS allied to market development efforts. Winrock International has successfully undertaken similar household energy projects in other countries including Chad, Kenya, Rwanda, Brazil, Nicaragua and Peru.

ENERGY EFFICIENCY: Improved Cook Stoves (24)

Title of Best Practice	The FAFASO Project
City/Town	Ouagadougou and Bobo Dioulasso
Country	Burkina Faso
Source	http://www.giz.de/Themen/en/dokumente/giz2011-en-factsheet-improved-stoves-burkina-faso.pdf

Background

Less than 7% of the population of Burkina Faso has access to modern fuels including electricity, liquid and gaseous fuels like LPG and natural gas. Around 85% of the country's energy needs are met using firewood and charcoal. Population growth especially in the main cities of Ouagadougou and Bobo Dioulasso has resulted in increased pressure on the country's forest cover causing severe deforestation. Monthly expenditure on firewood and charcoal in the two cities averaged 10% of household incomes.

Foyers Améliorés au Faso (FAFASO) project aimed at promoting the use of improved cook stoves (ICS) in the country's main cities. The capital Ouagadougou has a population of 2 million inhabitants while Bobo Dioulasso has 500,000 residents. FAFASO disseminated ICS units that save between 35% and 80% of wood and charcoal compared to the traditional three-stone fire. In addition to disseminating ICSs, the project provided training to stove producers and offered them assistance in developing commercial markets for their products.

Process and Innovation

FAFASO commenced in 2006. It was instigated by GIZ in partnership with the Dutch Foreign Ministry (DGIS), the German Ministry of International Cooperation (BMZ) and the Burkinabè Ministry of the Environment and Sustainable Development. The project led awareness-raising campaigns targeted mainly at women. These campaigns were conducted via TV, radio and through cooking demonstrations and sales events. The ICS disseminated by FAFASO included metal stoves for household and institutional use, ceramic household stoves and mud units used mainly for beer brewing.

The project's main innovation was centered on an approach that was different from previous government-led ICS interventions. These previous projects had as their central thrust the subsidization by donors of stove prices meaning that more often than not, sales plummeted with the end of donor funding. FAFASO focused instead on capacity building to train metal workers, masons and potters (pictured above left) to enable them to sell the stoves commercially ensuring that the dissemination of ICS units would continue unhindered even at the end of the project.

Outcomes

By the end of 2011, 200,000 stoves had been sold under the FAFASO project. Between 2006 and 2010, FAFASO trained 313 metalworkers in the production of metal stoves. 180 potters were trained in the production of ceramic stoves and an additional 264 masons were trained in the construction of stoves used for beer brewing. The metal and ceramic household stoves offer daily

fuel savings equivalent to US$ 0.21. Metal stoves for institutional use and the mud stoves intended for beer brewing offer daily fuel savings estimated at US$ 1 and US$ 4 respectively.

A study assessing the impacts of FAFASO found that 90% of the households who had purchased the stoves used them on a daily basis. At least 50% of the metal stove producers in Ouagadougou and Bobo Dioulasso reported higher incomes from sales of ICS units compared to the period prior to the project.

Sustainability
FAFASO ICS units emit less indoor air pollution and heat helping to reduce the incidence of cardio-vascular and respiratory diseases. The stoves are not only making a positive contribution to improved health and poverty reduction, they are also helping to protect the environment by reducing pressure on the country's forest resources and lowering GHG emissions.

The project is also financially and operationally sustainable. Beneficiaries reported that they spent less money of fuel and that the stoves cook more quickly and are more reliable. FAFASO has trained artisans in business management and set up associations with dynamic functional structures which will enable them to produce and disseminate the stoves after the conclusion of the project. A commercial chain bringing producers together with salesmen has been put in place with stove sales points in major towns and cities across Burkina Faso. FAFASO supported relevant government institutions in formulating policy frameworks for the promotion of ICS as a key tool in tackling desertification and reducing poverty.

Lessons Learned
The project realized that the production and distribution of ICS with market based mechanisms i.e. without direct subsidies is beneficial for producers and stove users. To achieve this, artisans need to determine the sales price of stoves based on their production costs ensuring that they are sold at prices that are profitable for producers and affordable for consumers.

Transferability
The project can be successfully replicated in cities where the pressure on forest resources poses environmental challenges. However, its successful replication will require the formation of strong partnerships between the implementing organization, local stove producers and the national government. The successes realized by FAFASO can be partly attributed to the fact that it was linked to the Burkinabè government's national strategy to protect forest resources.

ENERGY EFFICIENCY: Improved Cook Stoves (25)

Title of Best Practice	Toyola Efficient Charcoal Cook Stoves
City/Town	Accra
Country	Ghana
Source	http://energy-access.gnesd.org/index.php?option=com_content&view=article&id=95:toyola-efficient-charcoal-cook-stoves&catid=3:projects&Itemid=24

Background

In 2009, 52% of households in Accra used charcoal for cooking. This represented a 17% increase in the number of households using charcoal over the previous eight years. Charcoal consumption is even higher in other urban centres away from Accra. According to the Global Forest Resource Assessment of 2005, Ghana's forest cover reduced at an annual rate of 2% in the fifteen years from 1990. For poor households in Accra, the cost of charcoal takes up a significant proportion of household income and is mostly burned in inefficient polluting stoves.

Toyola Energy Limited was established in 2006 to supply better quality stoves and energy systems and appliances to low income households in Accra. The company manufactures and sells its own brand of energy efficient cook stoves. The Toyola stove is 40-50% more efficient than traditional stoves and greatly reduces the amount of charcoal needed for cooking.

Process and Innovation

Toyola Energy Limited obtained a loan from E+CO. E+CO supports local energy entrepreneurs in developing countries seeking to provide sustainable solutions to meet the challenges of poverty and climate change. The loan enabled Toyola Energy to start commercial production and sales of stoves and to provide work for artisans trained under the Ghana Household Energy Program (GHEP). The artisans make the stove components and assemble stoves to the company's specifications. The stove design was developed in collaboration with the users and artisans to make sure that the product complied with local cooking practices and consumer needs. The final stove design was a result of optimization, testing and user acceptance assessments conducted in order to better meet the demand of the consumers. Toyola Energy sells the stoves both directly and via dealers and local marketing agents who work on commission. The stoves are sold in five different sizes to cater for both the domestic and commercial markets.

Toyola Energy's main innovation was the company's responsiveness to the economic situation of Ghana's urban poor. More than 75% of customers buy stoves on credit. The customers who purchase the stoves on credit use the *"Toyola Money Box"* where savings accrued from reduced expenditure on charcoal is used to make repayments. The company also allows a small number of customers to pay for the stoves by bartering farm produce like cassava.

Outcomes

The Toyola stoves are sold at a price set just above production costs and can be used for three years. Health surveys conducted following sales showed that burns from accidents resulting from the use of inefficient cooking stoves had been reduced by over 90%. The incidence of eye irritation, shortage of breath and coughing as a result of indoor air pollution had also been reduced. The stoves reduce GHG emissions, decrease deforestation and provide benefits to users in the form of relief from high fuel costs, faster cooking which results in time savings and increased cleanliness and convenience.

Following the rapid acceptance of the Toyola stove by consumers, the company expanded its sales to reach cities and towns outside of Accra. The stoves are also available in two of the neighboring countries Togo and Burkina Faso. Annual savings accrued from using the new stove averaged US$ 27 which is a substantial amount for households that live on annual incomes of US$ 800.

Annual stove sales increased from 21,000 in 2007 to 52,000 in 2010. A total of 154,000 Toyola stoves had been sold by the end of March 2011. According to the company's sales data, only 3% of sales in 2010 were of commercial stoves. More than 90% of sales comprised domestic stoves sold in Ghana and 6% of sales were from stoves exported to Togo and Burkina Faso. By 2011, Toyola had through stove sales offset over 140,000 tons of carbon dioxide emissions and provided employment for more than 300 people (pictured above left).

Sustainability

The Toyola stoves usually replace older traditional models that burn wood and charcoal less efficiently polluting homes and releasing harmful GHGs. Studies assessing charcoal savings showed that the medium-sized domestic Toyola stove uses one-third of the charcoal used by the traditional stoves. This leads to savings averaging 0.5 kg of charcoal every day reducing deforestation. The financial sustainability of Toyola's initiative stems from the savings made by the beneficiaries. The payback period calculated based on the monetary savings brought about by using the Toyola stove is three to four months.

Lessons Learned

Because women and children are the ones most severely affected by indoor air pollution, they stood to benefit the most if households invested in the Toyola stove. However, in many cases it is men who make decisions on new investments and for them, smoke in the kitchen or inefficient cooking practices may not be reason enough for purchasing a more efficient and environmentally friendly stove. Toyola Energy found that engaging men and raising their awareness on the advantages of the new stove highlighting the economic benefits was important for the success of the initiative. The company also benefitted greatly from its initiative's close linkage to GHEP a national program which provided a ready supply of artisans who were trained in stove production.

Transferability

The simplicity of stove technology as well as the relatively low capital investment makes Toyola Energy's initiative easy to replicate. However, in order to succeed and to reach large numbers of users and eliminate complaints on the quality of the stoves, quality assurance and standardization systems need to be put in place to augment the training provided to artisans and technicians involved in the manufacture and assembly of ICS units. This would be in addition to the distribution network such as the one put in place by Toyola Energy Limited.

ENERGY EFFICIENCY: Improved Cook Stoves (26)

Title of Best Practice	Cambodian Fuelwood Saving Project
City/Town	Phnom Penh
Country	Cambodia
Source	http://www.ashden.org/files/reports/GERES%20Cambodia2006%20Technical%20report.pdf

Background

With a population of 2.3 million, Phnom Penh is the capital of Cambodia. For the residents of Phnom Penh, charcoal is the preferred cooking fuel used by 40% of the city's households. Prior to the commencement of the Cambodian Fuelwood Saving Project (CFSP), the charcoal was burned using a portable ceramic stove with a metal liner known as the Traditional Lao Stove. The use of charcoal was unsustainable and illegal logging of local forests was becoming a major issue. Pollution from the use of charcoal and wood also had adverse health impacts on women causing respiratory disease and heart and eye complications.

CFSP was introduced by GERES a French NGO. GERES works to alleviate poverty using renewable energy technologies and delivered CFSP in partnership with the Cambodian Ministry of Industry, Mines and Energy and a local NGO called Development and Appropriate Technology. The partners developed the New Lao Stove an affordable, efficient charcoal stove. The dissemination of the new stove was intended to reduce household fuel consumption and expenses as well as the health hazards resulting from unmitigated indoor air pollution.

Process and Innovation

CFSP started in 1997. The project's target group included cook stove producers and distributors and households, commercial institutions and restaurants in Phnom Penh that used charcoal and wood for cooking. The New Lao Stove was developed in collaboration with artisans and based on the fundamental design of the Traditional Lao Stove. Like the Traditional Lao Stove, it is made from a fired ceramic pot but includes a zinc bucket as its outer casing. The space between the ceramic pot and the zinc casing is packed with rice husks to improve insulation, minimize heat loss and thus improve efficiency. The use of rice husks for insulation ensures that the external surface remains cool and safe to handle.

The project established a producer and distributor association in order to protect the standardized product. Centralized training centers ensured stove producers were equipped with the right skills to gain admission to the producer association and become part of a Quality Seal system. GERES set up a micro-credit fund to help establish a production and distribution network for stoves. A promotional campaign was launched to raise awareness and increase knowledge among customers about the benefits of using the stove. The promotional tools included video clips, posters and demonstrations which were used to highlight the difference in cooking time and fuel consumption between Traditional Lao and New Lao Stoves. Production and distribution was fully commercialized in 2002.

CFSP's main innovation was based on its emphasis on sustainable use of wood for charcoal. This saw the development by the project of community forests and plantations as well as the use of efficient charcoal kilns which produce higher quality charcoal using less wood.

Outcomes

By the mid-2006, 137,000 units of the New Lao Stove had been sold. This number had risen to 160,000 by 2010 with the majority of users living in Phnom Penh. Field tests have shown that compared to the Traditional Lao stove, the new stove disseminated by CFSP reduced charcoal consumption by 22%. This translates to approximately 0.5 kilograms of charcoal every day corresponding to a significant reduction in the demand for charcoal directly reducing deforestation and GHG emissions. In addition to reduced fuel costs for families, CFSP has reduced exposure the exposure of low income households to health-damaging airborne pollutants, enabled faster cooking resulting in time savings and increased cleanliness and convenience. New jobs have also been created along the stove's production and distribution chain.

In 2007, CFSP became eligible for carbon finance. This made it the first stove project to do so under the Voluntary Carbon Standard. This income has been used to scale up the project expanding CFSP beyond Phnom Penh.

Sustainability

By reducing the demand for charcoal, CFSP has succeeded in reducing unsustainable consumption of wood resources thus enhancing efforts to protect Cambodia's forest ecosystems and biodiversity. The 32,000 tons of charcoal saved between 2003 and 2009 translates to 212,000 tons of green wood not cut and 769,000 tons of GHG emissions saved.

The project was also operationally and financially sustainable. Users were able to pay the full stove price with no subsidies or credit offered. While the New Lao Stove costs three times more than the Traditional Lao Stove, it has a longer service life. The fair price structure put in place by GERES also means that the outlay can be recouped within six months from the accompanying fuel savings.

Lessons Learned

Although GERES led the delivery of CFSP, having a multidisciplinary partnership with expertise encompassing a broad range of fields was key to the success of the project. The partners worked closely with the Institute of Standards of Cambodia ensuring the project was able to develop quality assurance measures. Since the basic design of the New Lao Stove can be easily reproduced, it was important to introduce measures to deter counterfeiters. CFSP stoves have a quality seal and a unique serial number that allows a stove to be traced back to its source. This meant that the threat from inferior products that would be detrimental to CFSP was minimized.

Transferability

CFSP has been scaled up and the New Lao Stove is available in seven other provinces of Cambodia including Takeo, Kandal, Kampot, Kampong Chhnang, Kampong Cham, Battambang, Siem Reap and Prey Veng. This followed the project qualifying for income from carbon finance which allowed expansion into more remote and less populated areas of the country where operational costs are higher.

RENEWABLE ENERGY: Community Biogas (27)

Title of Best Practice	Kibagare Haki Zetu Bio-centre
City/Town	Nairobi
Country	Kenya
Source	http://www.umande.org/umande-projects/list-of-bio-centers/item/24-kibagare-haki-zetu-bio-centre

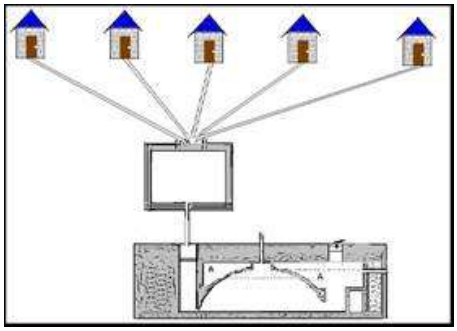
Background

An estimated 15,000 people live in Kibagare an informal settlement in Nairobi. Prior to the Kibagare Haki Zetu Bio-centre project, the settlement's sanitation system consisted of a few private plot-based latrines and unevenly distributed and poorly maintained communal latrines. Unsanitary practices like open-defecation and the use of flying toilets (polythene bags used to dispose of human waste) were common place. The lack of proper sanitation facilities was exacerbated by the high cost of safe drinking water purchased from private vendors. The inadequate provision of sanitation added to the scarcity of affordable safe water often resulted in the spread of water-borne diseases such as cholera, dysentery, diarrhoea and typhoid.

Water-borne diseases have been identified as the leading killers of children below five years of age in informal settlements in Kenya. The Kibagare Haki Zetu Bio-centre project's objective was to improve the quality of life of Kibagare residents while providing them with access to affordable modern energy, water and sanitation facilities managed by the community. Umande Trust a national NGO was responsible for the design and construction of the bio-centre. Funding for the project was provided by the Swedish government.

Process and Innovation

Umande Trust mobilized the community to ensure that the project was able to proceed on schedule. The community provided in-kind contributions in the form of space for the construction of the bio-centre as well as subsidized labour. The Kibagare Haki Zetu Welfare Group was formed under which committees were set up to handle issues such as works, tendering and procurement. The welfare group was also responsible for the promotion of transparency in the management and administration of the facility once its construction was completed.



The bio-centre was completed in the middle of 2011. It consists of a bio-digester and a water kiosk. The bio-digester is located in the basement of the building which also contains toilets and shower facilities in its ground floor. The water sold at the kiosk is obtained from the Nairobi City Water and Sewerage Company. Members of the Kibagare community pay a fee to use a biogas-powered communal kitchen and the toilets, showers and on-site laundry facilities. The top floor of the building contains 2 rooms which have been rented out as office space providing the community with an additional revenue stream.

The project's main innovation lay in its ingenious utilization of the Kibagare topography. The bio-digester was connected to satellite toilets located within the informal settlement (illustrated above left). This arrangement results in more feedstock being available for anaerobic digestion increasing the amount of biogas produced.

Outcomes

The facility serves between 600 and 800 users every day enabling the production of $11m^3$ of biogas. In addition to eliminating the visual blight resulting from improper disposal of human waste, the biogas generated is used in the communal kitchen and to heat the water used in the showers. The first floor houses organizations that promote economic and social rights generating additional income for the center.

The construction of the bio-centre has also led to improved governance from within the community with transparency and accountability being accorded the highest priority. The profit generated by the facility is paid out in the form of dividends to members at the end of the year. There are plans to maximize the utilization of the biogas produced by piping it to supply a nearby elementary school. The school is owned by the community and the biogas will be used for cooking to reduce the school's current reliance on firewood and charcoal.

Sustainability

The bio-centre facilities are available to the Kibagare community on a pay for use basis. This means that there has been no additional financial input from the donors after the project was completed underlining the financial sustainability of the project. The project has ensured environmental sustainability by contributing to a reduction in the use of firewood and charcoal that lead to deforestation. The presence of the facility in Kibagare had the effect of making it easier to manage the human waste generated in the informal settlement effectively turning the liability of improperly disposed human faeces into a tangible asset.

Lessons Learned

In order to achieve long-term sustainability and ownership of the project, it was important to ensure that the operation, management and maintenance of the bio-centre would be in the hands of the local community. Forming an effective partnership with the community enhanced the project's chances of succeeding. The popularity of the bio-centre as judged by the overwhelmingly positive reaction of the community to the services it provides has illustrated that poor communities also aspire to live in clean, hygienic environments and to have access to modern energy. It also proved that they are willing to pay for services provided the fees charged are set at reasonable levels.

Transferability

The Kibagare Bio-centre project was implemented based on other successful water, sanitation and energy projects in other informal settlements in Nairobi. These include the Katwekera Bio-centre in Kibera. Those projects highlighted the potential of cost-effective, well maintained community sanitation facilities to reduce the menace of open defecation and flying toilets while producing clean, affordable biogas energy. The Bio-centre model continues to interest a number of agencies and individual benefactors. UN-Habitat is constructing Multi-functional Clean Energy Centres (MCECs) in informal settlements in select African cities. MCECs are bio-centres designed to utilize other renewable energy components including solar PV and wind energy. Roof-mounted solar PV modules provide the energy used to power a solar lantern charging station housed within the facility. Wind energy is used to generate additional power for the MCEC. This enables the use of additional loads for productive activities such as computer and office equipment usage or vocational training.

RENEWABLE ENERGY: Domestic Biogas (28)

Title of Best Practice	Pilot Project for the Installation of Domestic Biogas Plants
City/Town	Bamako
Country	Mali
Source	http://www.docstoc.com/docs/30941774/Biogas-in-Peri-Urban-Areas_-Mali

Background

In Mali, more than 90% of households and small industry energy needs are met using wood and charcoal resulting in the over-exploitation of wood resources in the country's urban and peri-urban regions. Urbanization has drastically increased the population of the capital, Bamako placing a huge strain on wood resources. The resulting loss of vegetation has led to further desertification in a country where desert cover is approximately one-third of total land mass.

Bamako's peri-urban areas are made up of small-scale farming households who rely on traditional biomass sources mainly firewood for cooking and heating purposes. Women and children spend a lot of their time gathering firewood and are the most exposed to the resultant indoor air pollution. Mali Folkecentre Nyetaa a local NGO implemented the Pilot Project for the Installation of Domestic Biogas Plants. Project funding came from the UNDP's Small Grants Programme (SGP). The objective of the project was to reduce reliance on firewood and to improve the health of women and children by reducing their exposure to indoor air pollution.

Process and Innovation

The project started in 2000 with a feasibility study conducted to understand the local conditions. Five farms consisting of households that were large enough to consume significant amounts of wood or charcoal and which had enough cows to produce sufficient feedstock for anaerobic digestion were selected for the installation of biogas demonstration plants. In addition to contributing towards labour and material costs, the farmers participating in the project undertook to serve as promoters of biogas technology. The floating drum metal drum bio-digester systems installed each produced 2.5m^3 of biogas per day from an input of 100 kg of cow dung. The energy produced corresponded to an average of 40% of the energy consumed on the farms. A sixth bio-digester was installed at a nearby educational institution. The biogas plant situated at the institution serves as a demonstration site for the purposes of teaching.

The project illustrated the importance of adapting technology to local conditions to ensure that it works in the local setting. This was hugely important because, prior to this project, biogas initiatives in Mali could not be sustained. The materials used were not locally available and were not adaptable to local conditions. This project addressed both of these problems and has met with greater success as a result. Another innovation involved the incorporation of awareness-raising measures to help improve access to information about biogas technology. This included a national seminar to which public officials, development agencies and other stakeholders were invited and the development of project publicity material including brochures, posters and radio and television messages aimed at educating the public on the efficacy of biogas technology.

Outcomes
The biogas installations offered a reliable solution to land degradation caused by over-reliance on wood for fuel by converting livestock waste into useful energy. High quality fertilizer was also produced as a by-product. Local forests and vegetation were under less pressure as a result of the decreased use of firewood. The project helped improve the health conditions of women and children by reducing their exposure to indoor air pollution. They spend less time and effort collecting firewood and are able to utilize their time more productively.

The project helped remove technical barriers to biogas use and trained a new generation of biogas technicians who became newly aware of biogas technology and its benefits in combatting deforestation.

Sustainability
For the beneficiaries of the pilot project, the installation of the household biogas systems has eliminated the reliance on firewood and charcoal as the primary source of energy for cooking. Other factors that make the project sustainable are the exclusive use of locally available materials in the construction of the bio-digesters and the incorporation of local conditions into the design of the systems. The project also integrated capacity development for local farmers and their participation from the beginning in the construction and design of the systems prepared them for their new role in promoting the uptake of the technology.

Lessons Learned
The uptake of biogas in Mali had been hampered by technical barriers and the installation of units that were not well designed leading to sub-optimal performance. Mali Folkecentre's project incorporated the training of local community members in the design, installation, operation and maintenance of biogas systems. This will serve to remove some of the technical barriers to more widespread use of biogas technology.

Transferability
The project has good prospects for being successfully replicated and even scaled up in other locations. It kick-started the use of biogas plants in the urban and peri-urban areas around Bamako. Between 2004 and 2006, SGP funded other biogas projects in 4 other areas. 20 more digesters were installed with a total of 60 people benefiting from training similar to that offered during the delivery of the Pilot Project for the Installation of Domestic Biogas Plants.

RENEWABLE ENERGY: Institutional Biogas (29)

Title of Best Practice	Biogas in Rwanda Prisons
City/Town	Cyangugu Prison
Country	Rwanda
Source	http://www.icrc.org/eng/resources/documents/feature/2010/rwanda-feature-2010-11-18.htm

Background

As a result of Rwanda's tumultuous past, by the beginning of the new millennium, the country's prison population had increased to about 120,000. Sewage disposal became a major health hazard for the prisons and the surrounding areas with the waste produced outstripping the institutions' waste handling capabilities. The demand for firewood which was the main source of fuel for cooking and heating in prisons also increased in direct proportion to the number of prisoners.

Cyangugu is a city in Rwanda's Western province. The city's prison hosted 6,000 inmates. Septic tanks and sewage pits which were frequently overloaded were used to process the waste. Some human waste was being disposed near natural water bodies such as Lake Kivu. Cyangugu prison became the site of a project to construct biogas digesters with the aim of treating the waste from inmates to generate biogas to meet energy needs. This would ease the pressure on local wood supplies. The project was part of an institutional biogas project undertaken in the main prisons in Rwanda. The photo (above) shows the typical stock of wood in the prisons before the commencement of the institutional biogas project. The project was implemented by the Kigali Institute of Science and Technology (KIST) with funding provided by Penal Reform International and the government of Rwanda.

Process and Innovation

KIST was responsible for the construction of the bio-digesters. Civilian technicians from the area around the prison and prisoners benefitted from on-site training in bio-digester construction, operation and maintenance. The biogas system became operational in 2001. It consisted of two biogas plants of 75 m^3 each and four 100m^3 bio-digesters connected in series meaning that the total volume of the biogas system was 550m^3.

The project's main innovation was the construction of multiple digesters in series. This enabled compensation for fluctuations in the number of inmates at the prison which can lead to changes in the amount of waste generated for digestion. Arranging the digesters in series has the added advantage of ensuring sufficient retention time and enhancing biogas capture. Another innovation concerned the scale of the project. While using biogas digesters to manage animal or human sewage is not a new idea, the Cyangugu prison project applied it on an enormous scale and with great success.

Outcomes

The project achieved its objectives of providing clean energy, improving sanitation in the prison and reducing health risks and smells to which prisoners and neighboring residents had been exposed. The project led to time saving through cooking with biogas, financial savings accrued from substituting firewood with biogas and reduced incidence of disease outbreaks.

After treatment, the bio-effluent produced by the digesters is used as fertilizer in neighboring banana plantations and for production of vegetables grown in the prison garden for consumption by inmates. The project won the Ashden Award for Sustainable Energy.

Sustainability

The project enabled the effective management of Cyangugu prison sewer system while providing an ingenious solution that that improved sanitation conditions within the prison, reduced the cost of running the institution and contributed to the protection of the environment. The bio-digesters have reduced firewood consumption by at least 50% leading to annual financial savings of more than US$ 40,000 which is ploughed back into the institution to meet the costs of renovations and to improve services like healthcare.

By halving the consumption of firewood, the project reduced the deforestation that was being caused by unsustainable use of a finite resource and significantly reduced carbon dioxide emissions. The project also trained inmates and technicians from the prison neighbourhood. Private biogas businesses have been started as a result of the training that was provided by the project.

Lessons Learned

The biogas system was favourably perceived by the majority of prisoners who had initially feared the risk of disease and had expressed an aversion to food prepared with fuel generated from human waste. The fact that the gas produced was odourless and there were no side effects from eating food cooked with biogas eased these fears. The project also showed that biogas projects need to take into account factors such as the local climatic and geo-technical conditions, sanitary habits, waste flows and power relations in the prison and that for sites where the amount of feedstock is likely to fluctuate, it is advisable to install bio-digesters in series instead of using a single large one.

Transferability

The project undertaken at Cyangugu Prison can be replicated in other institutions that are occupied by large numbers of people and where the use biomass energy is unsustainable. As part of the institutional biogas project, digesters have been installed in prisons in other towns and cities in Rwanda including Muhanga, Gikongoro, Nsinda, Gitarama, Butare, Mpanga, Ririma, Nyagatare, Miyove, Rubavu and in the capital Kigali at Kimironko Prison. Other efforts to replicate the success of Rwanda's institutional biogas project included the building of biogas plants at a prison in Bamako, Mali by UN-Habitat. UN-Habitat also plans to undertake a similar initiative in Kamiti Maximum Security Prison in Nairobi.

RENEWABLE ENERGY: Industrial Biogas (30)

Title of Best Practice	Cows to Kilowatts
City/Town	Ibadan
Country	Nigeria
Source	www.globalgiving.org/pfil/1233/projdoc.pdf

Background

In Nigeria, the standards and regulations focussing on abattoir water pollution are poorly enforced. The consequences of abattoir waste pollution affect both human beings and the environment. Ibadan is Nigeria's second largest city with a population of about 3 million. More than 1,000 heads of cattle were slaughtered daily at the Bodija Market Abattoir in Ibadan with the waste running into open drains and finding its way into the nearby Bodija River. The Global Network for Environment and Economic Development Research (GNEEDR) discovered in a study conducted in 2000 that effluent from the river contained pollutants that far exceeded the national threshold for food processing industries. Communities living downstream from the abattoir were at serious risk as they used the polluted water for domestic purposes.

The *Cows to Kilowatts* project was initiated as a response to the environmental problems posed by the Bodija Market Abattoir. With funding from UNDP, the project started in 2001. It was implemented by GNEEDR, Biogas Technology Research Group (BRTG), the Centre for Youth, Family and the Law, the Sustainable Ibadan Project and the Federal Ministry of Environment, Housing and Urban Development. BRTG is part of the King Mongkuk University of Technology in Thailand while the Sustainable Ibadan Project is a UN-Habitat initiative.

Process and Innovation

Initially, the suggested solution for dealing with hazardous waste from the abattoir involved the construction of an effluent treating plant to handle the waste and prevent it from nearby polluting surface and groundwater sources. However, it quickly became apparent that such a plant would create an additional problem with the decomposing organic material producing methane and carbon dioxide. The project subsequently adopted BRTG's anaerobic fixed film reactor technology used in the treatment of agro-industrial waste and the production of biogas (left).

Innovations included the engagement of South-South technology transfer with the participation of BRTG and the use of the fixed film reactor technology. In addition to providing an elegant alternative to processing the abattoir waste using the effluent treating plant initially mooted by the project, the technology also has the advantage of shortening the amount of time it takes for complete digestion. The plant in Ibadan was the first in the world to simultaneously treat abattoir waste and provide domestic energy and organic fertilizer.

Outcomes

The biogas system built by the *"Cows to Kilowatts"* project became operational in 2008. The project's outcomes included substantially reducing the pollution of Bodija River through the treatment of about 3,500m^3 of abattoir waste water daily. It contributed to the avoidance of about 23,000 tons of carbon dioxide-equivalent emissions annually from methane emission from the abattoir waste dump and the generation of 1,800m^3 of biogas.

The biogas generated daily is the equivalent of 0.5 MW of electricity. It is used to generate 200 kW of electricity to power abattoir operations. Clean, affordable cooking gas is supplied to about 5,400 households who being energy poor had previously used traditional biomass for cooking. As a result of the project, 4,500 farmers can purchase high quality organic fertilizer from the abattoir.

Sustainability

The *Cows to Kilowatts* project is environmentally sustainable. It offered a solution to waste treatment which minimizes the carbon footprint of the Bodija Market Abattoir. Water pollution caused by abattoir waste was substantially and local households gained access to a clean cooking fuel leading to a reduction in indoor air pollution. The project is also operationally sustainable. Selling the biogas and fertilizer generated from the waste means that the plant was able to become a profitable enterprise providing employment opportunities for local people.

Lessons Learned

The project demonstrated the viability of converting abattoir waste into affordable energy and fertilizer that can benefit a large number of poor households. Another key lesson learned was the importance of partnerships in which each party has a clearly defined role. In the delivery of the *Cows to Kilowatts* project, GNEEDR initiated the project and coordinated it with Sustainable Ibadan Project, BRTG designed the plant while the Centre for Youth family and Law was responsible for working to engage local stakeholder groups. This clear delegation of duties was instrumental to the successful delivery of the project.

Transferability

Replication of the project is possible within Nigeria and other sub-Saharan African town and cities that face similar problems caused by pollution from abattoirs. Following the success of the *Cows to Kilowatts* initiative, there are plans to replicate it in 6 other major Nigerian cities. An abattoir in Kiserian outside Nairobi which processes between 120 and 150 head of cattle a day has successfully replicated the *Cows to Kilowatts* project.

RENEWABLE ENERGY: Municipal Solid Waste to Energy (31)

Title of Best Practice	eThekwini Landfill Gas to Electricity Project
City/Town	Durban
Country	South Africa
Source	www.cityenergy.org.za/files/resources/implementation/08Waste.pdf www.dbnlandfillgas2elec.co.za

Background

At the time of its commissioning, the eThekwini Landfill Gas to Electricity project was the first project of its kind in Africa. It is still the largest landfill gas to electricity generation initiative on the continent. The aim of the project was to utilize landfill gas for the generation of electricity to be supplied to the city of Durban and households in the areas around the landfill sites that faced the challenges of energy poverty. Three landfill sites in Bisasar Road, Mariannhill and La Mercy were selected for the project. The landfill site at Bisasar Road is one of the busiest in Africa receiving between 3,500 and 5,500 tons of Municipal Solid Waste (MSW) daily.

The project was undertaken by the City Council of eThekwini in partnership with the eThekwini Electricity Department. The City Council's Cleansing and Solid Waste Department was responsible for plant construction, administration and commissioning. The electricity department was charged with connecting the sites to the local electricity grid. Part funding for the project funding was obtained from the Department of Trade and Industry's Critical Infrastructure Program. The project was Clean Development Mechanism (CDM) registered meaning that it could generate income for the municipality through the sale of carbon credits to offset buyers. One of these buyers is the World Bank Prototype Carbon Fund (PCF).

Process and Innovation

Construction works commenced at the beginning of 2006. Project delivery was divided into two components. Component One encompassed the development of the landfill sites in Mariannhill and La Mercy while the second component was solely devoted to the development of the Bisasar Road site. 1 MW and 0.5 MW generators were installed at the Mariannhill and La Mercy sites respectively while the Bisasar Road landfill site had a generation capacity of 8 MW.

The project faced a number of challenges in its early stages. Construction works started four years and three months after the signing of the first contract between the municipality and PCF. The delays were caused by the protracted processes involving negotiations with PCF, Emissions Reductions Purchase Agreement (ERPA) negotiations and the Environmental Impact Assessment process. These challenges were overcome through the efforts of officials at the Cleansing and Solid Waste Department who acted as project champions leading the project through all these administrative hurdles. Despite the lengthy processes involved, the project's main innovation was the use of CDM funding as it became evident that the project would not have been viable without CDM registration.

Outcomes

Due to operational difficulties, the La Mercy site was decommissioned in 2009. Bisasar Road landfill's output is 6.5 MW generated using six 1 MW engines and a 0.5 MW engine relocated from the decommissioned La Mercy site. The Marianhill site generates 1 MW of electricity. The project has resulted in significant improvements in the quality of the local air capturing methane gas which would otherwise escape from the landfills and using it productively.

Households located close to the sites consume some of the electricity generated from the landfills. For the municipality, the generation of 7.5 MW of electricity from the landfill sites has led to a reduction in the reliance on coal-fired power stations cutting GHG emissions and mitigating climate change and global warming.

The project has had additional benefits for the local community leading to new employment opportunities. These include skilled jobs in the operation and maintenance of landfill and the power generation equipment. The project also generates income for the municipality totalling about US$ 550,000 a month from the sales of carbon credits and electricity.

Sustainability

The project led to the improvement of the local and global environment through better management of waste and landfill gas while generating clean electricity. The new capacity has been used to replace some of the electricity generated from coal powered stations which emit polluting gases. Some 35,000 tons per year of GHG emissions are being offset from the landfill site at Mariannhill. An additional 250,000 tons per year in emissions are offset at the Bisasar site. The project has also provided social development opportunities with employment opportunities and skills transfer and provided CDM income for the municipality. The project flares methane to produce carbon dioxide. This process of flaring methane which is a far more potent GHG than carbon dioxide is responsible for more of the project's income than the generation of electricity. However, with the increasing price of electricity in South Africa, the income from the generation of electricity will surpass that from the flaring of methane in the near future.

Lessons Learned

The majority of landfill sites belong to municipalities which stand to benefit substantially from methane flaring and the generation of green electricity. In order to succeed, initiatives such as the eThekwini Landfill Gas to Electricity Project need to have high level city council buy-in from the beginning. The direct involvement of the mayor and the City Manager from the earliest stages of the project including the carbon credit negotiations with PCF was vital to the project's success.

Transferability

Depending on their size, cities generate tens of thousands of tons of MSW every day. In many developing countries, waste is dumped without any treatment and without regard for the environment. The unprecedented growth of urban populations represents an obvious opportunity for municipalities to utilize the increasing quantities of MSW in ways that will be beneficial to cities. One of the most convenient ways to do this is through landfill gas to electricity projects. CDM funding and renewable energy feed-in tariffs where they exist can be used to ensure projects' economic feasibility.

RENEWABLE ENERGY: Wind Generated Electricity (32)

Title of Best Practice	Assab Wind Energy Project
City/Town	Assab
Country	Eritrea
Source	www.er.undp.org/docs/eri_terminal_review_wind_energy_project.pdf

Background

Eritrea has a large electricity generation shortfall making supply to industries and homes erratic and unreliable. Assab is a port city on the Red Sea with a population of approximately 40,000. The city possesses abundant wind energy resources but was served exclusively by a diesel power plant. Power supply from the diesel plant was insufficient especially during hot seasons when the demand for electricity was at its highest. Due to this generation shortfall, many poor households relied on kerosene for lighting or old privately sourced diesel generators which were also used by many SMEs in the city (left).

In 2004, UNDP, the Ministry of Fisheries, the Ministry of Energy and Minerals and the private sector embarked on a project funded by the Global Environment Fund (GEF) and the government of Eritrea to demonstrate the potential of wind generated energy in parts of the country with good wind speeds. Other project objectives included the development of skilled manpower to plan, design, install, operate and maintain wind energy systems and the reduction of GHG emissions from diesel generating plants. If successful, the project would also ensure that the use of wind energy systems was considered in future national electrification plans.

Process and Innovation

The project commenced with wind speed assessments in Assab. The results of this exercise supported the assumption that the city had abundant wind resources. Vergnet S.A a French wind turbine construction company was contracted to erect 3 turbines each producing 275 kW of electricity at a wind farm. The electricity generated at the proposed wind farm would total about 25% of the city's consumption enabling the replacement of some of the old diesel generators while augmenting the city's power supply.

The main challenges faced by the project stemmed from the lack of local experience with wind energy and the fact that the existing grids were only intended for diesel generation of electricity. These challenges were overcome by reinforcing the grid to enable the integration of the wind farm into the city's electricity distribution network.

Project innovations included linking the initiative to Eritrea's national energy strategy which prioritized the development of sustainable energy systems with a view to reducing dependency on fossil fuels. The project also consulted exhaustively with all the relevant stakeholders and incorporated pertinent results from previous activities including an unsuccessful wind turbine project which was part of a Swedish International Development Cooperation Agency (SIDA) funded initiative.

Outcomes

As a result of the project, residents of Assab benefitted from a more reliable electricity supply for lighting, ventilation and cooling systems in a very hot city. Low income households previously without electricity connections were connected reducing the need to use kerosene lanterns. The electricity from the wind farm (pictured left) is also used for the preservation of fish which is the main commercial activity in Assab.

The savings from the decommissioning of diesel generators amounted to US$ 730,000 annually. Carbon dioxide emissions were reduced by about 18,000 metric tons per year. Its successful implementation has served to strengthen Eritrea's fledgling wind energy sector with the improvement of the capacity of personnel, government institutions and private companies in the installation, operation and maintenance of wind energy systems.

Sustainability

As expected, the project had a number of positive environmental impacts. The reduction in air pollution resulting from the replacement of some of the old diesel generators with a renewable energy source leads to better health for the city's population while contributing to the abatement of climate change and its well-documented local and global threats. Due to the financial savings made in the costs of diesel and the high operation and maintenance costs of the diesel generators, the Assab Wind Energy project was expected to have a break even period of between six and seven years. The wind farm also represents a valuable demonstration site which will show actors in the energy sector the economic and technical feasibility of using wind power for the production of electricity. The wind farm's lifetime has been estimated at 20 years.

Lessons Learned

The project successfully demonstrated that on-grid wind energy can be a viable and reliable electricity supply source in sites with good wind regimes. It also highlighted the importance of clearly defined roles for the various stakeholders and strong political will for the success and ownership of projects. Another key lesson learned concerned the necessity of establishing synergies with on-going energy related activities. For the Assab Wind energy project, this included the government's commitment to increasing the contribution of renewable energy in the national electricity generation mix.

Transferability

The project has had the desired effect of stimulating the market for wind energy systems in Eritrea. Its successful implementation is expected to lead to the removal of many of the technical and economic barriers to widespread use of wind energy systems. Private companies are expected to show interest in investing and operating wind farms. This can be in the form of public-private partnerships forged with the Eritrean Electricity Authority the government utility responsible for electricity generation, transmission and distribution.

RENEWABLE ENERGY: Micro-hydro Power (33)

Title of Best Practice	Community Based Watershed Management and Water Resource Utilization for Hydro Power
City/Town	Davao
Country	Philippines
Source	http://sgp.undp.org/index.php?option=com_sgpprojects&view=projectdetail&id=3904&Itemid=205#.USeNBjdu6M8

Background

The electricity grid is located about 58 kilometres away from Polocon, a peri-urban farming community on the outskirts of Davao the third largest city in the Philippines. Before the advent of the micro-hydro project, only a few households had electricity and there was no sign that the community would be connected to the grid in the near future.

The project which commenced in 1998 was implemented by Yamog Renewable Energy Development Group, Inc. and the Polocón Farmers Association later rebranded Polocon People's Multi-Purpose Cooperative. Funding was provided by the Small Grants Program (SGP). Project objectives included the reduction of the technical, institutional and informational barriers that hampered uptake of community-managed micro-hydro schemes and to demonstrate the significant environmental and livelihood benefits that can result from the implementation of such schemes.

Process and Innovation

Polocón is situated within a 70-hectare watershed. The watershed was incorporated into the project due to its importance to the flow of the river that was to be used for the micro-hydro scheme. Restoring and protecting the watershed was among the first activities undertaken. Subsequently, a 15 kW micro-hydro system was constructed to supply electricity to 78 households. The community formed the Polocón People's Multi-Purpose Cooperative which comprised women's group members and members of the defunct Polocón Farmers' Association.

The project's innovations included the active participation of the Polocón community. They received training in the management of the micro-hydro system and were involved in the construction process enhancing community ownership of the project. The project which was linked to the government's larger environmental and electrification goals also carried education activities to ensure that the community was aware of the connection between the hydro-scheme and the preservation of the watershed.

Outcomes

The 78 households electrified by the project stopped using kerosene lamps reducing their vulnerability to its harmful effects. The electricity generated by the micro-hydro plant is also used to power a corn mill (left), to provide lighting for the local elementary school and for coffee hulling and battery charging improving the community's educational and economic conditions.

Community involvement and the capacity building exercises undertaken out by the project have built up technical understanding among Polocón residents about the construction, operation and maintenance of the micro-hydro plant. They are able to manage the plant on their own without relying on any external assistance.

The project achieved national recognition and won an award for the most innovative new and renewable energy initiative from the Philippine National Oil Company and the Society for the Advancement of Technology Management in the Philippines.

Sustainability
The project is operationally sustainable. The community are now able to grind their corn, a staple crop in the region for less and pay less for battery charging and coffee hulling. These services are also offered at a cost to people from the neighbouring communities enabling Polocón residents to generate some additional income. The community's participation in new income generating activities has also been spurred by the availability of a reliable supply of electricity.

It is also environmentally sustainable as the construction of the micro-hydro scheme was inextricably linked to the restoration and maintenance of the watershed on which the supply of water to the river depends. The conservation of the watershed has helped maintain good water supply for Polocón and the communities downstream resulting in reforestation of local farmlands and pastures with native species and fruit trees. This has led to the restoration of the local ecosystem. As a direct result of the project, watershed protection has been institutionalized with all the pupils from the local elementary school required to plant and care for trees.

Lessons Learned
The project successfully linked the provision of basic energy services to the protection of the environment via efforts to restore and protect the watershed. This approach represented a very effective means of promoting conservation efforts. The building of a sense of community ownership of the project was vital to its successful implementation. The Polocón community's participation in this project began even before the scheme was conceptualized and continued with their investment of considerable amounts of time and effort during the construction of the micro-hydro plant. The community's active role in all the stages of the project was critical in sustaining their long term involvement in the management, operation and maintenance of the scheme.

Transferability
Yamog Renewable Energy Development Group, Inc has organized for Polocón community members to provide technical assistance to other communities aiming to set up similar projects. A total of 22 more community-based micro-hydro power schemes have been completed in neighboring towns and villages.

RENEWABLE ENERGY: Solar PV (34)

Title of Best Practice	OSRAM Energy Hubs
City/Town	Mbita
Country	Kenya
Source	http://www.siemens.com/innovation/apps/pof_microsite/_pof-spring-2009/_html_en/inexhaustible-light-for-lake-victoria.html

Background

Mbita is a small town on the shores of Lake Victoria with a population of 8,000. The main occupation amongst the population of Mbita in common with the other towns situated along the lake's shore is fishing. Kerosene lamps are the main source of lighting in the town's households. Kerosene lamps are also used by fishermen during their nightly fishing expeditions. The fuel's main attraction for poor communities with low and irregular incomes stems from the fact that it can be purchased in small, affordable quantities.

OSRAM is a subsidiary of Siemens the engineering and electronics conglomerate. OSRAM provides sustainable lighting solutions for off-grid markets. The widespread use of toxic, inefficient kerosene in Mbita and the surrounding towns presented the company with an attractive market opportunity. Mbita was selected as the location for the piloting of the OSRAM Energy Hub project.

Process and Innovation

In 2008, OSRAM and Global Nature Fund (GNF) a development aid organization built the first energy hub in Mbita Town. An energy hub is a small electrical charging station powered using roof-mounted solar PV modules. The energy hub in Mbita is operated by Thames Electrical and offers solar lanterns, mobile phone charging and clean drinking water purified through ultra violet sterilization.

The main challenge was the difficulty of convincing the town's residents to ditch their kerosene lamps for solar lanterns. OSRAM, GNF and Thames Electrical realized that the successful substitution of kerosene use was going to have to be a gradual process requiring targeted awareness-raising demonstrations clearly highlighting the financial and environmental benefits of using solar lanterns.

The project's main innovation was that it represented a high profile effort by a large multi-national company to design a product specifically targeting the low income households which constitute a substantial market opportunity. OSRAM also realized early on that a refundable deposit paid prior to renting solar lantern units rendered the arrangement unaffordable to the majority of Mbita residents with average monthly incomes below US$ 30. To counter this potential hindrance to the success of the project, the partners worked with local MFIs which offered small loans to residents to enable them pay the deposit ensuring that people who needed the lanterns would be able to afford them.

Outcomes

The solar lanterns available for lease from the energy hub can when fully charged offer up to 8 hours of 7W of lighting for household and commercial use including fishing. The energy hub can recharge 48 mobile phones using roof-mounted solar PV modules. Mobile phone charging costs less at the energy hub compared to other premises that offer the same service. The last feature of the OSRAM energy hub is the solar powered water purification plant. Rain water is collected in a tank next to the hub before being subjected to ultra violet sterilization and sold in containers of varying sizes. The energy hub can process 3,000 litres of water every day.

The availability of modern lighting made possible by the project has reduced reliance on kerosene which according to GNF is responsible for the emission of 50,000 tons of carbon dioxide per year in the towns located on the shores of Lake Victoria. The use of the solar lanterns has led to significant financial savings for households and raised the productivity and the incomes of fishermen and people who run small businesses in Mbita. School children have benefited immensely from having reliable, high quality lighting for reading and studying.

Sustainability

The Mbita energy hub is locally managed providing employment opportunities for locals who would otherwise be unemployed. The lighting products offered at the hub have improved livelihoods by providing better quality illumination at significantly reduced costs. Renting and recharging a lantern at the energy hub costs 30% less than using kerosene and eliminates dangerous pollution and fire risks associated with using the fossil fuel.

The construction, installation and operational phases of the project promoted technology transfer resulting in the training of locals. The materials and the labour used in the construction of the energy hub were all locally sourced. Only material that was not locally available was imported. The availability of clean drinking water has also improved health outcomes by reducing the risk of illnesses like cholera caused by the consumption of untreated water.

Lessons Learned

The OSRAM Energy Hub combined the provision of lighting services, mobile phone charging and clean drinking water all of which were needed by the community in Mbita. The pilot project illustrates that fact that while kerosene is a widely used lighting fuel, innovative approaches specifically targeting low income customers can enable its substitution with renewable energy-based, environmentally friendly alternatives.

Transferability

The success of the pilot project has led to its replication in other locations. OSRAM has built energy hubs in three more lakeside towns in Kenya and Uganda and there are plans to build more hubs based on the same principles in Africa and in Asia.

RENEWABLE ENERGY: Solar Water Heating (35)

Title of Best Practice	Renewable Energy for Daily Life: Solar Water Heating in El Menia
City/Town	El Menia
Country	Egypt
Source	http://www.solarthermalworld.org/sites/gstec/files/SGP_Egypt3.pdf

Background
Egypt receives some of the highest annual solar radiation in the world yet poor families in poor neighbourhoods of the city of El Menia in Northern Egypt remained heavily dependent on agricultural residues and wood to heat their domestic water. To address this situation, the Society for Community Welfare and the Coptic Evangelical Organization for Social Services embarked on a project to install solar water heaters (SWH) in poor households in El Menia. Funding for the project was obtained from the Small Grants Programme.

The project had the objective of introducing the use of solar energy to heat water. It also intended to raise awareness about climate change and the effects of pollution produced by the use of biomass as a source of domestic energy. Egypt's Renewable Energy Authority the government agency which promotes the use of sustainable energy resources also participated in the project.

Process and Innovation
The installation of the SWHs commenced in 1998. The project sought competitive bids from suppliers and carried out training programs on the installation, maintenance and repair of SWHs. A number of local technicians benefitted from the training.

Project innovations included making it mandatory for community members to contribute part of the cost of the water heaters. The household contributions were used to supplement the SGP funding allowing more heaters to be installed and increasing the sense of ownership among beneficiaries. The project placed great emphasis on awareness-raising and educated hundreds of El Menia residents on the connection between unsustainable biomass energy use and global and local environmental problems.

Outcomes
SWH units each with a capacity of 150 litres were installed in 164 houses. The project led to reduced use of agricultural waste and wood for heating water reducing the amount of smoke released into the air. Improved access to hot water also helped improve sanitation. It is estimated that the SWHs installed by the project resulted in monthly monetary savings averaging US$ 2 for the beneficiary households. Another outcome of the project is that it increased demand for the technology leading to a reduction in the cost of SWH systems in the country.

Sustainability
The project proved to be environmentally sustainable. The use of solar energy to heat water for domestic purposes reduced the need to use agricultural waste or other traditional biomass fuels. This resulted in a reduction in GHG emissions and an improvement in indoor air quality in the beneficiary households. Reduced smoke inhalation constitutes a major health benefit.

The project's operational sustainability credentials are underlined by the fact that it resulted in significant annual cost savings for the households estimated at US$ 24. It also provided employment opportunities for 21 young people who were trained as technicians. The newly

acquired skills in the installation, repair and maintenance of SWHs enabled the technicians to earn incomes even after the conclusion of the project.

Lessons Learned

The project highlighted the importance of community participation, awareness-raising and collaboration with the private sector. Community participation led to buy-in from the project beneficiaries while the relationships developed with SWH manufacturers which culminated in the issuance of the invitation to tender ensured that the heaters disseminated by the project were reasonably priced and of high quality. The project worked closely with pertinent government departments such as the Renewable Energy Authority which promotes the use of renewable energy technologies. The fact that the project complemented existing national renewable energy and environmental protection strategies meant that it was able to receive the support of the government whenever this was required.

Transferability

The El Menia project was the first in a series of thirteen SGP-GEF projects installing SWHs in urban poor households in Egypt. Subsequent SWH projects all trained local technicians which is important in removing technical barriers to the dissemination of the technology.

RENEWABLE ENERGY: Solar Water Heating (36)

Title of Best Practice	Rhizao Solar Water Heaters Program
City/Town	Rhizao
Country	China
Source	www.onearth.org/article/a-sunny-day-in-rizhao

Background

Rhizao is a city with a population of 2.8 million located in Shandong province in Northern China. Electric water heaters were used by the majority of households in Rhizao leading to high energy bills. With annual incomes averaging US$ 3,800, Rhizao households have a lower per capita income than those in most Chinese cities. The relatively low incomes combined with the high bills caused by the prevalent use of electric heaters made it important to explore solutions that would lead to reduced household energy expenditure. The city receives ample sunshine every year meaning that solar water heaters (SWH) represented a viable alternative to electric heaters.

A municipal government policy in Rhizao requires the full implementation of solar energy and building integrated applications. All civil architecture in the city's urban planning area and at county district level must include the application and integration of solar thermal systems in the design and construction of new buildings. The Rhizao Solar Water Heaters Program reinforced this policy making it mandatory for buildings in Rhizao to install SWHs. It was undertaken by the city of Rhizao, the Shandong provincial government and players in the local solar energy sector. It aimed to popularize SWHs by increasing their efficiency and lowering their costs to the end user thus reducing reliance on coal from which the city's power supply was derived.

Process and Innovation

The program started with a regulation under which all new buildings were required to incorporate SWHs. The mayor of Rhizao acted as the program champion driving the passing of the necessary measures and regulations. The municipality was responsible for overseeing the installation of the SWH systems to ensure standardization and proper installation. Awareness-raising campaigns including open seminars and public advertising were also conducted.

The program's main innovation was the use of provincial government subsidies for research and development activities. Local solar energy players used the subsidies to improve their products with emphasis placed on increasing the efficiency of their SWH systems while reducing unit costs to consumers.

Outcomes

The results of the program have been positive. Rhizao boasts more than 1.2 million square metres of SWH cover. As of 2012, 90% of the households used SWHs. The program also successfully reduced the unit costs of SWHs.

The standard 120 litre SWH system costs US$ 190 which is equivalent to the cost of an electric heater and about 5% of the annual income of the average household in Rhizao.

The program led to a reduction in the city's reliance on coal. The total volume of pollutants emitted has reduced in line with the reductions recorded in the consumption of electricity generated using coal. The program also led to new employment opportunities in the local SWH industry.

As a result of the program, Rhizao was designated the Environmental Protection Model City by China's State Environmental Protection Administration and has been consistently listed in the top 10 cities for air quality nationally.

Sustainability

The program has succeeded in reducing the city's carbon emissions and local pollution pointing to its environmental sustainability. Rizhao reduced its energy consumption by 30% and achieved annual carbon dioxide savings of 52,860 tons. By 2007, conventional electricity usage had been reduced by a total of 348 GW per year. It also proved operationally sustainable while effectively addressing the financial constraints faced by the city's households. Investing in research and development activities for SWHs has had the effect of lowering their cost significantly bringing them down to levels comparable to the cost of electric heaters. Using a solar water heater for 15 years costs US$ 1,934 less than running a conventional electric heater over the same period of time. This equates to savings of US$ 120 per year for every household investing in the technology.

Lessons Learned

There are similar programs that have focussed on funding the end users or subsidizing the cost of SWHs. The Rhizao program with its technological breakthroughs illustrated that the cost of SWHs can be brought down substantially by subsidizing research and development activities. The program also highlighted the importance of a program champion. The city's mayor played a significant role in the design and delivery of the program and in leading the formulation of the regulatory framework that made it possible for it to be implemented.

Transferability

The program can be replicated with political will and regulatory support to encourage solar energy use and the active involvement of the local renewable energy sector.

RENEWABLE ENERGY: Solar Cookers (37)

Title of Best Practice	AFIMA Solar Cookers Promotion Project
City/Town	Bamako
Country	Mali
Source	http://www.trust.org/alertnet/news/women-engineers-promote-low-carbon-cooking-across-mali/

Background
The Association of Women Engineers of Mali (AFIMA) undertook a project to address the challenge of deforestation in Mali. AFIMA's Solar Cookers Promotion Project was carried out in partnership with the KoZon Foundation which is a Dutch NGO. A low-carbon cooking kit was developed to alleviate the pressure on the country's forest resources.

The cooking kit consists of a solar cooker in the form of a box lined with reflective foil, a metal pot and a heat-resistant plastic bag. It also comes with an insulated "thermos" basket in which food is put to prevent it from becoming cold.

Process and Innovation
AFIMA designed the cooking kits and started making and marketing them in Bamako in 2001. The abundant sunshine in the Malian capital means that the weather is suitable for cooking using the kit most days of the year. AFIMA trains women in the making of solar cookers. For all the cookers sold, AFIMA collects data on customers' fuel use before and after they purchased the units. This data is used to assess charcoal and firewood consumption and savings.

Among the project's innovations is the fact that the solar cookers were designed and made by women who are themselves involved in their use. The data on fuel consumption that was collected by the project informed the design of new models of the solar cookers ensuring that they are responsive to the needs of the users. The project also conducted awareness raising outreach sessions to address potential resistance to what represented a new way of cooking. This was important because using solar cookers instead of charcoal and firewood stoves required users to make a significant shift from local cultures and traditions.

Outcomes
The use of the solar cookers has contributed to the reduction of deforestation reducing exclusive reliance on charcoal and firewood for cooking while curbing indoor air pollution. The data from the end-user monitoring conducted by AFIMA indicate that on average, the solar cookers cut charcoal use by 360 kg per household. Savings from reduced consumption of charcoal were estimated at US$ 80 per year.

The project reduced drudgery for women and also provided employment opportunities for a number of previously unemployed women in Bamako. The training they received from AFIMA has enabled them to find work either in the production or marketing of solar cookers.

Sustainability
The project is operationally, financially and environmentally sustainable. The materials used for making the solar cookers are all locally sourced reducing unit costs to the end users. Since energy from the sun is abundant and is obtained for free, the cookers have led to significant financial savings for all those who purchased them. The project can continue in its original form without external funding as the income generated from selling cookers can be used to meet the costs of making new units. By reducing the use of traditional biomass fuels that accelerate desertification, the project has had environmental benefits including the lowering of GHG emissions by an estimated 3.2 tons per household and reducing the incidence of eye and myriad respiratory diseases among women and children.

Lessons Learned
The dissemination of the solar cookers met some resistance from people who were used to cooking with firewood and charcoal and for whom using AFIMA's solar cooker represented a radical shift from tradition. The project's success was anchored on the awareness raising campaigns which highlighted the urgent need to save the country's forests from further depletion and also focussed on the economic savings to be made from using solar cookers. The latter message coupled with inflation that increased financial pressure on households especially those with low incomes meant that there was a real and urgent need to accept and adapt alternative means of cooking.

Transferability
Due to the simple design of the AFIMA solar cookers, the technology can be easily transferred and utilized in regions with sufficient solar resources. In 2012, AFIMA expanded its project. The move will see it promote the use of the solar cooker in all of Mali's eight regions. AFIMA is also seeking to promote parabolic solar cookers which cost more but can capture more solar energy due to their larger surface areas.

RENEWABLE ENERGY: Bioenergy (38)

Title of Best Practice	Ethiopia Ethanol Stoves Project
City/Town	Addis Ababa
Country	Ethiopia
Source	www.projectgaia.com/files/AboutProjectGaia.pdf

Background

Before the commencement of the Ethiopia Ethanol Stoves project, the most widely used fuels for cooking in Addis Ababa were kerosene and firewood used by more than 70% of the city's households respectively. Only 7% of Addis Ababa households used modern fuels like LPG or electricity for cooking. An indoor air pollution survey conducted by Gaia Association confirmed the presence of high concentrations of harmful pollutants in homes where kerosene and biomass were used as the main cooking fuels.

The Ethiopia Ethanol Stoves Project was instigated following the study by Gaia Association. Implementation partners included Gaia Association, the Ministry of Mines and Energy, the Ministry of Trade and Industry, the United Nations High Commissioner for Refugees (UNHCR) and Finchaa Sugar Factory. The project's objective was to promote the use of ethanol as a household energy fuel in order to curb indoor air pollution. Funding for the project was provided by the Shell Foundation's Sustainable Energy Program, the United States Environmental Protection Agency, the International Rescue Committee and the Lutheran World Foundation.

Process and Innovation

In 2004, Gaia Association started a pilot project distributing liquid ethanol fuel for use in households in Addis Ababa and in UNHCR-run refugee camps located around the city. The refugee camps were inhabited by people who had fled the war in Somalia. They relied exclusively on firewood as their cooking energy. Ethanol was distributed along with the CleanCook stove a purpose-made alcohol stove (pictured left).

The pilot project successfully demonstrated the marketability of ethanol as a cooking fuel showing that households were willing to use ethanol as a substitute for kerosene and firewood. The next stage of the project involved the commercialization of the production and distribution of ethanol and CleanCook stoves. Ethanol was supplied by Finchaa Sugar Factory. Gaia Association worked with Makobu Enterprises a well-established private sector partner to produce CleanCook stoves.

The project's innovations included ensuring that there was an enabling environment for the dissemination of ethanol fuel and CleanCook stoves. This was done by supplying the fuel at reasonable prices and levying realistic taxes on the raw materials used to make the stoves. The project also patented the stove ensuring that investments made in its design and manufacturing were not unduly jeopardized by the availability in the market of counterfeit stoves.

Outcomes
Ethanol is a much safer and less polluting fuel than kerosene and firewood. The project has brought positive change to the lives of low income Addis Ababa and refugee households by improving the quality of indoor air. It also resulted in the creation of new jobs in stove production. Other jobs were created in ethanol distilleries and in the ethanol and stove distribution chain. In addition to reducing health risks for households which switched over to ethanol as their primary cooking fuel, the project had the effect of reducing deforestation and reducing drudgery for women and girls. Using ethanol instead of firewood has reduced average cooking times by up to 30 minutes.

As a result of the project, three other distilleries started producing ethanol to meet the rising demand for the fuel. The project won the Ashden Award for Sustainable Energy in 2008.

Sustainability
The Ethiopia Ethanol Stoves project is operationally and financially sustainable with the presence and proximity of sugar factories in the project location ensuring the availability of a sufficient supply of ethanol for the newly created household market. The ethanol is produced locally from natural materials like molasses that would otherwise have been characterized as waste from the sugar industry and dumped unscientifically causing harm to the environment. While the use of traditional biomass fuels endangers the country's remaining forest cover, kerosene like other petroleum products is imported at great cost to the Ethiopian people. This makes it imperative that households have better, more efficient energy choices like the one provided by the project

The project is also environmentally sustainable. Its objective of replacing traditional biomass usage with the use of clean modern energy is in line with the government's efforts to mitigate climate change and deforestation. The CleanCook stove produced only half the carbon monoxide and less than 1% of the particulates that would have been produced by traditional stoves.

Lessons Learned
The introduction of ethanol into the household energy market has demonstrated that people are willing to step up the energy ladder and use cleaner, safer cooking fuels as long as they are able to afford it. The fact that end users were able to pay less for a litre of ethanol than for the same quantity of kerosene was crucial to the success of the project. Making ethanol available in small, daily quantities, especially for low income households was also an important contributory factor to Project Gaia's success.

Transferability
The commercialization of the CleanCook stove to create a stable, self-sustaining market will make both the CleanCook stove and ethanol available to more poor residents of Addis Ababa and other Ethiopian cities. The project has been successfully replicated in other countries including Brazil and Nigeria. In urban and rural households in Minas Gerais State in Brazil, the stoves distributed use ethanol while those disseminated in the Niger delta use methanol which is more readily available in that region of Nigeria.

ENERGY MANAGEMENT: Social Tariffs (39)

Title of Best Practice	The Low Income Social Tariff
City/Town	Nationwide
Country	Brazil
Source	http://pdf.usaid.gov/pdf_docs/PNADO642.pdf

Background

The main barrier to access to modern energy services for people living in informal settlements has been identified as the unaffordable upfront costs required meeting the costs of legal electricity connections and wiring. Responsive policies can be used to overcome this daunting barrier. In Brazil, the Low Income Social Tariff (LIT) was created in 2002 following the advent of Electricity Sector Law number 10.438 which illustrated the government's intention to meet the service needs of lower income families. The law mandated that electricity companies achieve 100% coverage in their service areas by pre-determined dates. Consequently, the companies faced increased service obligations for a segment of customers considered to have little or no return value on investment primarily because most were already illegally connected to the grid.

A national fund known as the Energy Development Account was created to assist the achievement of universal electricity access. The National Electricity Regulatory Agency (ANEEL) was made responsible for monitoring the progress and the results achieved by electricity utilities in meeting their universal access targets. The Ministry of Mines and Energy was charged with determining the total annual cost of implementing the social tariff. These costs were to be shared by all electricity customers with wealthier households subsidizing poorer ones.

Process and Innovation

All customers with monthly electricity consumption ranging between zero and 220 kWh over the previous 12 months became eligible for varying levels of discounts on their tariffs depending on their consumption.

The major challenge involved ensuring that only those households which genuinely needed the social tariff benefited from it. This was overcome through a requirement that only those households registered on the Federal Governments' assistance programs for the poor and those with average incomes not exceeding half of the minimum wage were eligible for the LIT. These terms ensured that non-poor households were eliminated from the LIT rolls and those large households with low incomes and monthly electricity consumption in excess of 220 kWh were included.

In terms of innovation, the implementation of LIT and Electricity Sector Law 10.438 required electricity companies to spend a proportion of their net revenues on energy access and energy efficiency measures including the distribution of new energy efficient appliances in informal settlements. Promoting energy efficiency is an effective demand-side management measure that has the effect of minimizing consumption while ensuring that the quality of electricity supply remains high.

Outcomes

At the beginning of 2009, approximately 17 million out of 50 million electricity customers were paying LIT. Out of this number, 14 million consumed less than the stipulated 80 kWh of electricity

per month and were paying the lowest tariff. 75% of Brazilians live in urban areas meaning that many of the people who benefited from the introduction of LIT can be categorized as the urban poor.

In 2006, a project led by USAID, the International Copper Association and AES Eletropaulo was carried out in Paraisópolis, an informal settlement in Sao Paolo. AES Eletropaulo is the Sao Paolo state electricity distributor. The project which was only made possible by the introduction of LIT targeted a total of 4,365 households and commercial entities in the informal settlement and included the installation of meters, new electrical wiring and connections regularizing customers who had been obtaining their electricity illegally. Community awareness-raising campaigns were also carried out to improve the efficiency and affordability of householders' electricity use.

At the end of the project, electricity consumption in every Paraisópolis household had reduced by an average of 40% making them eligible to pay more affordable rates under LIT. While its primary focus was to reduce theft from the electricity grid, the project anchored on LIT with its highly favourable regulatory support.

It succeeded in providing previously disenfranchised households with a legal address and proof of identity through electricity bills. This enabled them to access credit facilities and other pertinent services. For the utility, the benefits accrued from the project included improved revenues due to improved bill collections which went up from virtually no payment to a remarkable 68% paying.

Sustainability

Substantial losses to the economy due to electricity theft associated with illegal connections have been drastically reduced highlighting the operational sustainability of the social tariff. The provisions of Law 10.438 and LIT also proved to be environmentally sustainable. Refrigerators and lighting represent around 90% of a low income household's energy consumption. Replacing inefficient old refrigerators with efficient new ones and incandescent light bulbs with CFLs reduced per capita consumption and had a positive environmental impact through reductions recorded in GHG emission.

Lessons Learned

In order for social tariffs to be implemented successfully, it is important that they incorporate financial viability for the electricity utilities while ensuring affordability for the customer. Satisfying these conditions contributed immensely to the success of LIT. For low income urban households, the awareness raising and distribution of energy efficient appliances were also of major importance. As Paraisópolis households were previously not paying for their electricity, they did not have any incentives to control and regulate their electricity consumption. Legalizing their connections unaccompanied by the drive for energy efficiency would very likely have meant that even with LIT in place, the low-income households would have found it very difficult to afford their bills due to their high energy use.

Transferability

The successful replication of LIT in other cities would depend on the prevailing local legislative and policy environments. However, the highly favourable pro-poor legislative and regulatory conditions present in Brazil may not exist in other countries.

ENERGY MANAGEMENT: Social Tariffs (40)

Title of Best Practice	Depressed Area Electrification Program
City/Town	Manila
Country	Philippines
Source	http://pdf.usaid.gov/pdf_docs/PNADB219.pdf

Background

Starting in 1965, successive governments and the state power utility Manila Electric Company (MERALCO) provided subsidies covering the first 60 kWh of monthly electricity consumption for all residential customers. By 1985, this had been increased to the first 200 kWh. During the intervening period, middlemen appeared in informal settlements in Manila which were either unserved or poorly served by MERALCO. The middlemen resold legally sourced electricity to the residents of informal settlements at a profit or illegally tapped the MERALCO network. This meant that poor households ended up paying more than they would have paid the utility had they been able to afford legitimate connection and service fees.

The middlemen thrived because MERALCO could not obtain right of way necessary to install facilities in the informal settlements (pictured left) since land ownership in these areas was either being contested or was undetermined. The Presidential Commission on Urban Poor (PCUP) was introduced in 1986. PCUP had the mandate of giving more political attention to the plight of the poor especially those living in the Manila Metropolitan area. The Depressed Area Electrification Program (DAEP) was part of the PCUP agenda.

DAEP's objective was to install distribution facilities and provide electricity to informal settlement households formalizing illegal users of electricity and connecting other users for the first time. DEAP was implemented with funding from the Japan Bank for International Construction. MERALCO's partners in the implementation of DEAP included the government and the National Electrification Agency.

Process and Innovation

DAEP was carried out over the ten years between 1990 and the turn of the millennium. Households became eligible for an individual lifeline tariff that was substantially lower than the fees charged by the suppliers of illegal electricity. Households were also eligible for subsidized connection fees as well as loans to meet the costs of internal wiring. These were no-interest loans repayable to MERALCO over a period of 5 years. MERALCO brought its distribution lines to the perimeter of the informal settlements and installed meter walls with individual meters. DAEP waived the cost of extending distribution lines to the meter walls which constituted the largest portion of the connection costs. Beneficiary communities formed neighbourhood associations which managed payment for the extension of distribution lines to their homes from the meter walls. The neighbourhood associations were also responsible for the management and policing of the system within the informal settlements to prevent acts of vandalism.

DAEP's main innovation lay in the use of meter walls located in highly visible areas at the perimeter of the informal settlements. Using meter walls from which each household was then connected to the grid enabled MERALCO to electrify informal settlement homes without having to secure right of way.

Outcomes

DAEP resulted in more than 300,000 households in Manila being either formalized or connected to electricity for the very first time. In addition to households paying lower prices for electricity occasioned by their eligibility for the lifeline tariff, DAEP significantly lowered connection and electricity service costs for low income communities while undercutting the influence of illegal suppliers.

The beneficiaries (pictured left) also had access to a more effective and reliable service, increased security and order, improved living conditions and better opportunities to engage in income generating activities. As a result of DAEP, MERALCO was able to reduce its technical and financial losses.

Sustainability

DAEP is operationally sustainable. Its implementation saw the formation of neighbourhood associations which were responsible for the management of the electricity networks within the informal settlements. These associations have had the effect of bringing better community governance to the fore. A positive legacy of DAEP has been the growth of these associations staffed with local management teams into action offices which are able to address other issues that are of importance to the neighbourhoods including water, safety and education.

In terms of financial sustainability, DAEP lowered the electricity bills paid by beneficiary households and increased MERALCO's profitability by reducing the influence of illegal electricity suppliers and cutting the technical and financial losses previously suffered by the utility.

Lessons Learned

DAEP demonstrated that it is possible to implement a relatively low cost and quick solution to electrify underserved and unserved populations using a social tariff allied to an innovative approach. The lifeline tariff made DAEP attractive for low income communities as it enabled them to pay lower bills for legally obtained electricity. Being able to pay lower rates for legal electricity served as motivation for informal settlement communities to effectively manage and police their own electricity networks.

Transferability

Supported by the requisite policy and regulatory frameworks, DAEP a relatively low-cost, innovative approach based on a social tariff can be successfully replicated in other cities whose low income populations face similar challenges with regard to accessing legal electricity.

ENERGY MANAGEMENT: Social Tariffs (41)

Title of Best Practice	Free Basic Electricity
City/Town	Nationwide
Country	South Africa
Source	www.earthlife.org.za/wordpress/wp-content/uploads/2010/03

Background

South Africa's "Electricity for All" initiative had universal electrification as its goal. However, the government realized that the increase in electrification rates would not be accompanied by meaningful levels of electricity consumption among poor households if they could not afford the electricity on offer. The inability to pay for basic electricity needs meant that many households were in arrears leading to disconnection by power utilities. The disconnections often lasted for months at a time negating the very concept of universal electrification. To counter this, the government introduced the Free Basic Electricity (FBE) policy in 2003.

The objective of FBE was to provide 50 kWh of free electricity a month for all low income South African households. It was assumed that the 50 kWh of electricity was sufficient to meet the basic lighting and domestic energy demands of poor households. They would consume the free basic electricity at no cost and pay the approved tariff for all units of electricity consumed above the free allocation. Responsibility for the implementation of FBE was given to ESKOM South Africa's largest electricity utility, the Department of Energy and the country's 243 municipalities. Funding for FBE came from the Department of Provincial and Local Government.

Process and Innovation

As a precondition to benefiting from FBE, only households with a legal connection to the national grid at a metered point of supply were eligible. Those with a record of non-payment and illegal connections were excluded until all bills were settled. Most of the households that benefitted from FBE were urban poor households including people living in government constructed Reconstruction and Development Program (RDP) housing (pictured left). In implementing FBE, some municipalities elected to provide a 50 kWh allocation to all households. Others only provided FBE to households below a poverty measure determined through means testing.

Innovative aspects of FBE included the installation of prepaid meters which have helped to limit illegalities, negotiate compliance and help citizens to better manage their own energy consumption. The prepaid meters also eliminated the problems associated with disputed and inaccurate meter readings. Another innovation was based on the fact that FBE offered free electricity. Similar initiatives have only extended to social tariffs under which eligible low income households pay discounted rates for their electricity consumption.

Outcomes
By 2006, it was estimated that more than 4 million South African households were benefiting from FBE bringing substantive improvements in the welfare of the urban poor. FBE enabled impoverished households to increase their electricity consumption. It resulted in a reduction of previously high levels of non-payment and electricity theft. FBE also led to a marked reduction in fire incidents in low income urban areas that resulted from the use of kerosene and candles. Kerosene and candles had been identified as the main causes of domestic fires destroying more than 100,000 homes annually.

Dangerous indoor air pollution was also reduced following the move from kerosene use. Another outcome of FBE was that it enabled income substitution. Disadvantaged households were able to use money that would have been spent on purchasing the allocated 50 kWh of electricity to pay for other domestic necessities.

Sustainability
The health and safety improvements in the home following electrification represent a major argument for the environmental and operational sustainability of FBE. Having access to electricity significantly reduced the emissions associated with the use of highly polluting solid and liquid fuels. With FBE, cooking with electricity is cheaper than using kerosene making it economically sustainable for low income urban households.

Lessons Learned
Following the commencement of FBE, there has been an argument that 50 kWh per month was too low for domestic use. While alternatives to redress this would include the introduction of subsidies for electricity consumption above the FBE allocation, a more effective approach would have been to encourage the use of energy efficient appliances and compact fluorescent lamps (CFLs) instead of incandescent bulbs and LPG cooking stoves in beneficiary households. Introducing energy efficiency measures would have had the advantage of increasing the effectiveness and impact of FBE by reducing electricity consumption thereby reducing the number of households exceeding their monthly allocations of free electricity.

Transferability
The clear links between poverty and energy make the implementation of tariffs and policies that enable increased energy access for disadvantaged households an important development strategy. However, social tariffs such as FBE would work best in countries which have sufficient supplies of energy. Replicating FBE in countries which run significant energy supply and demand deficits would constitute a major challenge.

ENERGY MANAGEMENT: Policy and Regulation (42)

Title of Best Practice Distributed Renewable Generation in Guatemala
Country Guatemala
Source www.naruc.org/international/Documents/GUATEMALA%20Case%20Study.pdf

Background
Although Guatemala has the largest economy in Central America, poverty levels in the country remain high. While progress has been made in recent years in line with the economy, the development of the domestic electricity generating capacity and the transmission infrastructure has not kept pace. Guatemala has great potential for the development of renewable energy but imported fossil fuels are used to meet more than 60% of electricity generation needs. Distributed Renewable Generation (DRG) i.e. electricity generation using renewable resources with installed capacities of less than 5 MW was seen as a potential solution to reducing reliance on fossil fuels while at the same time relieving energy poverty. The renewable energies highlighted under DRG are solar PV, wind, hydro, geothermal and biomass.

Despite the availability of substantial domestic hydroelectric energy resources, there has been a steady fall in the contribution of hydro power to Guatemala's electricity production mix. DRG was introduced as part of an attempt to modernize the energy regulatory framework in order to promote investment in renewable energy projects. The existing framework had failed to provide the requisite support for the construction of small renewable energy power plants. Stakeholders and potential investors reported that it offered limited guidance on the promotion of investment in renewable energy technologies. The framework did not allow power generating entities with capacities of less than 5 MW to participate fully in the electricity market.

Process and Innovation
In 2006, the Guatemalan electricity sector regulatory authority known as the Comisión Nacional de Energia Eléctrica (CNEE) determined that a new regulatory framework for DRG was necessary to spur new investments in renewable energy. Partners in the formulation of the new framework for DRG were the state-owned utility Instituto Nacional de Electrificación and the Ministry of Energy and Mines.

The introduction of the new, modernized framework involved the creation of the Technical Standard for the Connection, Operation and Marketing of Distributed Renewable Generation (NTGDR). NTGDR became operational in 2008 following an on-going process of consultation involving state market actors and private electricity generation companies in Guatemala and other Latin American countries. The policy features of the NTDGR included incentives for renewable energy sources and the placing of limits on the size of power plants to 5 MW or less.

Outcomes
The introduction of the regulatory framework which included private sector incentives such as exemptions from income tax, machinery import tax as well as the freeing of carbon credits from taxation created an enabling environment for the development of renewable energy resources.

By 2010, nine hydropower projects totalling 10.93 MW in capacity had been commissioned by CNEE. One of these projects was the upgrading and revitalization of an existing hydro plant in El Rodeo, a municipality of 36,000 inhabitants.

The project expanded the generating capacity of the hydropower plant (left) which generated 400 kW of electricity to produce 1.1 MW.

With a more reliable supply of electricity, shops, restaurants, bars and enterprises like barber shops are able to operate their businesses more effectively. Local households have better access to energy which has improved their quality of life. Children are able to read and study at night. Reduced reliance on kerosene, candles and batteries enabled El Rodeo households to save money meaning that they had more disposable income. The hydro plant has also created employment opportunities for 14 people including managers, engineers, plant operators and administrative and support staff.

Sustainability

Guatemala has abundant resources of hydro, solar wind, biomass and geothermal energy to meet its electricity generation needs pointing to DRG's operational sustainability. The available water resources and the private and state-owned hydroelectric projects have the capacity to generate 10,000 MW of electricity. DRG has reduced reliance on fossil fuel electricity generation contributing to the promotion of environmental protection.

Lessons Learned

The success of DRG can be attributed to a clear delegation of responsibilities. CNEE had explicit powers to develop policy meaning that other parties despite their own interests knew that the regulator was acting to ensure a more efficient and diverse electricity generation mix. Input from these parties was welcome allowing the development of the electricity generation sector in a manner consistent with sector expertise and knowledge.

Prior to the strengthening of DRG, only 7% of the putative 10,000 MW hydroelectric capacity was being utilized. DRG instigated nine new hydropower projects ranging in generation capacity from 0.5 MW to 2.16 MW. This highlighted the fact that incentives such as tax exemptions can be highly beneficial when they spur investments in projects that improve the livelihoods of unserved and under-served populations resulting in greater economic productivity.

Transferability

The development of focussed regulatory frameworks can catalyse the utilization of abundant renewable energy resources to overcome energy poverty and dependence on GHG emitting energy sources. However, as shown by DRG, the success of such a framework would still require the active participation of governments, regulators as well as assorted industry stakeholders.

ENERGY MANAGEMENT: Policy and Regulation (43)

Title of Best Practice	Barcelona Solar Obligation
City/Town	Barcelona
Country	Spain
Source	www.solarordinances.eu/Portals/0/STO%20template_Barcelona.pdf

Background

Solar thermal ordinances or solar obligations are legal provisions that stipulate that solar energy provides a share of the heating energy demand of buildings. They have been introduced in a number of countries, regions and local authorities in Europe and in other regions with varying degrees of success. The Barcelona Solar Obligation came into force in 2000. This was at a time when the solar thermal industry had grown and a new generation of reliable products was available in the market. It was also a time marked by rising energy prices and worries about the security of energy supply and increased global focus on issues pertaining to climate change. These conditions all served to ensure that the Barcelona Solar Obligation received widespread support from the public and from decision-makers. The Municipality of Barcelona was responsible for the implementation of the Obligation while the Barcelona Energy Agency was charged with its monitoring.

Process and Innovation

The Barcelona Solar Obligation was introduced following exhaustive consultation with stakeholders including professional associations and public bodies responsible for housing, urban planning and the protection of architectural and environmental heritage. Although mainly a solar thermal ordinance, the Obligation allows for the use of other renewable energy technologies. It applies to residential buildings containing more than 16 apartments and buildings intended for commercial and industrial use. Covering both private and public buildings, the Barcelona Solar Obligation made the owners of buildings responsible for ensuring that the solar thermal systems installed meet legal requirements. Buildings had to meet at least 60% of their hot water demand using solar thermal energy.

Enacting the legislation made Barcelona the first city in Europe to mandate the use of solar thermal power. A new version of the Obligation viewed as an upgrade on the first model was introduced in 2006. The main changes reflected the general positive experience with the Obligation as it increased both the number of buildings subject to its stipulations as well as the required solar fraction. Solar fraction is the ratio of the amount of energy provided by solar technology to the total energy consumed in a building.

Outcomes

Prior to the introduction of the Obligation, Barcelona's installed thermal capacity was twenty times lower than the EU average with only 1,650m^2 of installed solar thermal capacity. However, between 2002 and 2006, an additional 40,095m^2 of solar thermal was installed resulting in a reduction in carbon dioxide emissions totalling 5,640 tons per year. By December 2010, the city's solar thermal surface i.e. the surface area covered by solar water heaters had increased to 87,600m^2. Other outcomes of the Obligation have included technical and innovation development, decrease in fossil fuel expenses and the creation of new jobs in the renewable energy sector.

Sustainability
The Barcelona Solar Obligation has resulted in energy savings and a significant reduction in emissions by promoting the use of a renewable energy resource. At the end of 2010, the city was saving substantial amounts of carbon dioxide emissions contributing enormously to both local and global environmental sustainability. The Obligation is also operationally and financially sustainable. Owners of buildings and tenants have all benefited from paying lower energy costs. It has stimulated the local economy by creating jobs while requiring very little administrative overheads and minimal expenditure of public funds.

The Obligation is part of Barcelona's strategy to promote the installation of solar energy systems in the city. Other related initiatives have included the conversion of municipal buildings to solar PV energy and the introduction of solar-powered bus stops.

Lessons Learned
The main lesson learned was that the development of markets, the implementation of legal Obligations and awareness-raising activities around the obligations ought to be carried out in parallel. These are vital for the creation of social and political acceptance for a new regulation. The Obligation overcame barriers such as a lack of knowledge among building sector professionals on how to implement it. The specific actions taken to address this particular challenge such as technical seminars and vocational trainings were important in ensuring the successful implementation of the Obligation. Another factor contributing to the success of the Obligation was the commitment and buy-in shown by all the parties involved. These enabled the implementation of the Obligation in its original form and even allowed further improvements to be made.

Transferability
Following the implementation of the Barcelona Solar Ordinance, dozens of Spanish cities to wit Seville, Madrid and Burgos have introduced Obligations of their own. While not specifically targeted at the urban poor, the Barcelona Solar Obligation can be replicated to benefit low income households in developing countries where electricity, kerosene and firewood are the main energy sources used to heat water.

ENERGY MANAGEMENT: Financing (44)

Title of Best Practice	Project Urja
City/Town	Ahmedabad
Country	India
Source	http://www.growinginclusivemarkets.org/media/cases/India_SELCO_2011.pdf

Background

Self Employed Women's Association (SEWA) Bank is a Micro Finance Institution (MFI) registered as an urban cooperative bank. SEWA provides working capital and financial services for the socio-economic empowerment of poor, self-employed women in the Indian city of Ahmedabad and in the wider state of Gujarat. The bank offer energy loans used to finance the installation of solar home systems (SHS), the establishment of battery charging stations and the purchase of solar lanterns. The loans are targeted at women in urban and rural areas although self-employed women in urban areas make up 80% of the bank's clientele.

Under Project Urja (urja means energy in Gujarati) which commenced in 2006, SEWA disseminated credit to clients while its partners, the Solar Electric Company (SELCO) offered advisory support to clients on energy products. SELCO also installed the systems and provided after-sales services. The bank received funding from the Lemelson Foundation for onward lending and additional funding from the United Nations Office for Project Services (UNOPS). The funding from UNOPS was used to assess and document the energy needs of the beneficiaries prior to the commencement of the project.

Process and Innovation

The project offered unsecured energy loans up to a maximum of US$ 1,100 at an interest rate of 17%. The repayment period was set at 35 months with loans processed and approved in just a single day. The typical system purchased and installed under Project Urja consisted of a 35W roof-mounted PV module used to power four 7W lights and using a 90Ah lead-acid battery. The project also offered portable solar lanterns for women who work as market vendors for use after sunset.

The project's innovation lay in the flexible loan repayment terms offered by SEWA. Clients were allowed the option of repaying loans in variable instalments. An interest subsidy of 7% was offered on energy loans and refunded on the timely completion of repayment. This was especially important given the fact that the project was targeted at low income households.

Outcomes

When Project URJA formally ended in 2008, a total of 300 women in Ahmedabad had benefited from the energy loans it had disbursed. The solar home systems enabled households that previously had no access to modern energy services to enjoy the benefits of having access to reliable electricity. The SHS and the lanterns distributed by the project replaced kerosene lamps and offered cleaner and ultimately more affordable lighting solutions. In addition to the benefits to individual households associated with access to modern energy, Project Urja, through the dissemination of portable solar lanterns enabled vendors and other self-employed women to engage in income generating activities even after nightfall.

For the women involved in businesses, the solar lanterns enabled them to attract more customers addressing the dual challenges of inadequate lighting and the high cost of kerosene that they had experienced prior to the project.

The lanterns therefore served as convenient substitutes for kerosene lamps which in addition to being expensive and providing insufficient quality of light represented considerable risk of fire and damage to businesses and livelihoods.

Sustainability

By the time the project ended, SEWA energy portfolio had a repayment rate of 95% underlining its financial viability and sustainability for both the bank and SELCO. It was also environmentally sustainable. Project Urja enabled its beneficiaries to avoid the use of fuels that have been proven to be detrimental to their health and to the environment. A typical Indian family uses about 120 litres of kerosene per year for lighting so the systems disseminated by Project Urja led to substantial financial and emissions savings. The women were also able to increase their incomes and their productivity.

The project continued beyond the Lemelson Foundation funded phase. Women in Ahmedabad and other areas of Gujarat have continued to purchase solar PV systems from SELCO with credit provided by SEWA.

Lessons Learned

The main barrier to financing for individual renewable energy systems arises from the reluctance of banks and finance institutions to face the risks of what they perceive to be small markets lacking sufficient loan volumes. In order to succeed, projects based on the provision of micro finance for renewable energy systems need to incorporate measures that serve to address these concerns including the provision of technical support and financing to enable MFIs to venture into what constitutes a new market for them. Project Urja incorporated these measures. The requisite technical support was provided by SELCO while the Lemelson Foundation provided financial input.

Another significant contributor to the success of Project Urja was the similarity in mission, target clients and organizational values of SEWA and SELCO. This formed the basis of a successful partnership with clearly defined roles and responsibilities delegated to the two organizations enabling them to complement each other relying on the experience and expertise that they each brought to the partnership. SEWA had the financial services and an existing infrastructure to market the renewable energy technologies offered by SELCO. Working in partnership with SEWA meant that SELCO was able to reach new customers who would otherwise be unable to afford its products.

Transferability

The potential of MFIs like SEWA to finance loans to purchase energy systems to alleviate energy poverty has not been fully exploited. This can be attributed a dearth of documented success stories detailing micro finance as a useful tool for enhancing access to modern energy services. Successfully replicating Project Urja requires the identification of an energy partner with a mission, approach, client profile and organizational values similar to those of espoused by the MFI.

ENERGY MANAGEMENT: Financing (45)

Title of Best Practice	Mainstreaming of Urban Poor Women in Design for Resource Assessment
City/Town	New Delhi
Country	India
Source	www.esmap.org/sites/esmap.org/files/FINAL_EA-Case%20Studies.pdf

Background

About 45% of the population of New Delhi live in unauthorized colonies and informal settlements. The illegal status of the informal settlements prevent them from gaining access to important infrastructure and services including electricity from North Delhi Power Limited (NDPL), the city's main power utility. In two such neighbourhoods- Bhalla Factory and Jaipur Golden- 39% of residents live below the poverty line earning less than US$ 1 per day.

A local NGO, the Integrated Centre for Advancement of Reforms and Education (INDCARE Trust) conducted a study aimed at identifying barriers to securing access to electricity in New Delhi's informal settlements including Bhalla Factory and Jaipur Golden. The study identified high connection costs as the main obstacle preventing low income households from accessing legal electricity. A high proportion of low income households ended up relying on illegal electricity connections which posed serious safety risks and led to significant losses in revenue for NDPL.

In 2003, INDCARE Trust was approached by USAID and NDPL to build upon the study they had conducted and assist in the implementation of a project that would see the residents of the Bhalla Factory and Jaipur Golden gain legal access to electricity. The main objective of the project was to facilitate safe and legal electrification in the two neighbourhoods through microfinance and community education.

Process and Innovation

The project commenced in 2004 and focussed on the supply constraints identified by INDCARE and on improving the quality of services provided. INDCARE was responsible for acting as the intermediary between the community and the utility company. INDCARE also held sessions to educate the community on the benefits of legal electricity connections and helped the community understand their responsibilities as citizens to pay for the services that they consume.

Micro finance from local institutions was used to pay for new electricity connections and for meters. NDPL standardized the wiring in all the illegally connected beneficiary households and installed meters in every household. The USAID funding was used to subsidize the cost of the connections.

The project's innovation lay in its use of a tool known as Mainstreaming of Urban Poor Women in Design for Resources Assessment (MAURA). MAURA from which the project derives its title emphasized the active participation of women in the electrification exercise giving them access to micro financing they would not otherwise have accessed to help them meet the connection costs.

Outcomes

By the end of 2004, all the 850 households selected for electrification had been connected to the grid. As many as 5,500 people benefitted from the project which successfully overcame the seemingly insurmountable barrier of high connection costs.

Providing the beneficiaries with legal connections served to decrease the influence of the miscreants who supplied illegal electricity and helped NDPL reduce revenue losses while at the same time improving the quality of life for informal settlement households.

Sustainability

The project's financial sustainability is underlined by the fact that the loans given out for legal electricity connections were paid back in full and on schedule. As a result of legal electrification, new consumer relationships were established between NDPL and the beneficiaries. Providing the households with legal electricity connections helped transform disadvantaged and marginalized households into responsible consumers.

MAURA also succeeded in empowering women. In addition to the micro financing offered to meet electricity connection costs, the project helped them set up a savings and credit system through which they continue to access funding for business activities.

Lessons Learned

One of the key enabling factors for the success of the project was the desire of NDPL following privatization to expand its customer base to include informal settlements. Another important factor contributing to the project's successful implementation was INDCARE's role in bridging the communication gap between the community and NDPL. Achieving this ensured that the low income households were treated more fairly. MAURA changed previously held misconceptions enabling the communities in the informal settlements to be viewed as responsible consumers.

Transferability

The project started in the Bhalla Factory before being replicated on a larger scale in Jaipur Golden. While the availability of financing to meet connection costs is important, other ingredients for its successful replication include concerted outreach and education efforts to raise awareness and convey the benefits of legal electricity connections.

ENERGY MANAGEMENT: Planning (46)

Title of Best Practice	Cable Car Connectivity in Complexo do Alemáo
City/Town	Rio de Janeiro
Country	Brazil
Source	www.gondolaproject.com/riodejaneiro/

Background

With a population of 6.3 million, Rio de Janeiro is the second largest city in Brazil. The city has a comprehensive public transport system including buses, suburban trains and an underground train system. However, 20% of the population live in informal settlements which are typified by improper and unorganized development and a hilly terrain not supported by a public transport system. Informal settlements grew by 7% between 1999 and 2008. With a population of over 120,000, Complexo do Alemáo is the largest informal settlement in Rio de Janeiro. It was the location for the public infrastructure investment project that led to the construction of the first cable car (gondola) system in Brazil.

Prior to the advent of the gondola system, the unreliable transportation system had become a hindrance for residents of Complexo do Alemáo preventing them from accessing essential opportunities and services. They faced a daily walk up and down an unpaved hillside lasting between 30 minutes and an hour in order to get to the nearest commuter rail station. The gondola system was introduced with the aim of connecting Complexo do Alemáo to the city's conventional mass transit system through a modern, affordable and comfortable means of transport.

Process and Innovation

The Gondola Connectivity program was undertaken as part of PAC Brazil's Growth Acceleration program. PAC is an urban revitalization program that ranges from basic sanitation to new housing and social services ahead of the 2014 FIFA World Cup and Rio de Janeiro's hosting of the 2016 summer Olympic Games. It was introduced in 2007 laying out investment plans to address many long-overdue infrastructure issues. PAC relies on investment from federal, state and municipal government as well as from private and state companies to fund projects focusing on infrastructure, social issues and energy.

The gondola system is based on cable cars similar to those used in ski resorts. It was opened in the summer of 2011. The program's innovation is based on the choice of the cable car as a viable alternative to road and rail transportation. The terrain in Complexo do Alemáo is uneven and the passages too narrow and winding for conventional means of transport to be used as a feasible option for improving accessibility to the city for deprived communities.

Outcomes

The gondola system has reduced travel time from the furthest corner of Complexo do Alemáo to the nearest rail station to about 16 minutes. This has resolved the massive transportation challenges previously faced by the residents by connecting their neighbourhood to the rest of the city. The system runs for 3.5 kilometres through 6 stations which include 2 terminals and 4 intermediary stations. 152 gondolas each with a capacity of 10 carry about 30,000 people over the informal settlement every day.

The residents of Complexo do Alemáo are guaranteed two free rides a day on the system. Additional trips cost the equivalent of US$ 0.60.

Sustainability

The gondola system with its focus on the urban poor has ensured easier and faster access to employment and educational opportunities. Residents of Complexo do Alemáo have been saved from having to make tiring journeys through the steep and narrow roads. Connecting the informal settlement to Rio de Janeiro's mass transit systems has improved the overall accessibility of the city offering livelihood opportunities to people from disadvantaged communities. The fares paid by residents go into operating and maintaining the gondola system making it self-sufficient and operationally sustainable.

Lessons Learned

People from lower socio-economic groups rely almost entirely on public transportation to access employment opportunities, social services and leisure activities. Where the public transportation is inadequate as was the case in Complexo does Alemáo before the introduction of the gondola system, it hinders access to essential opportunities. Access to reliable public transport systems can remove these hindrances and provide opportunities for poor communities to thrive ensuring social integration.

Transferability

The opening of the gondola system in Rio de Janeiro made it the third Latin American city to introduce a cable-propelled transport system. Gondolas had already been successfully introduced to improve mobility and ease traffic congestion in informal settlements in Medellin and Caracas highlighting the transferability of the program.

ENERGY MANAGEMENT: Planning (47)

Title of Best Practice	The Habitat Program
City/Town	Mexican Cities
Country	Mexico
Source	www.energy-access.gnesd.org/index.php?option=com_content&view

Background

Although Mexico is rated a middle-income country, 46% of its population live in extreme or moderate poverty. About 40% of the inhabitants of the country's rapidly urbanizing cities does not have adequate access to infrastructure services including modern energy. The National Development Plan is Mexico's main planning instrument outlining national developmental objectives and strategies. The 2001-2006 National Development Plan had as its main principles the reduction of the major disparities in the standards of living in cities and the support of urban and social development in poor areas.

The Habitat Program is an example of the initiatives enabled by the 2001-2006 National Development Plan. The program commenced in 2003 with financing from the Mexican government through a loan from the Inter-American Development Bank (IDB). It has the objective of reducing urban poverty through the provision of targeted social services and modern infrastructure including electricity to low income households in informal settlements. The program's activities were coordinated by the Ministry of Social Development (SEDESOL) in partnership with the municipalities of more than 200 cities.

Process and Innovation

The 2001-2006 National Development Plan acted as a long-term policy guide forming the basis for public spending and was translated into a series of programs including the Habitat Program. SEDESOL worked closely with the participating municipals to implement the Habitat Program. The municipal governments play the role of intermediary between the federal government and the selected neighbourhoods and promote the participation of resident populations. The electricity utilities working in the cities were responsible for the design, operation and the extension of the grid into informal settlements where they also erected public lighting facilities. The program's activities were carried out in cities which had at least 15,000 inhabitants.

Funding for the electrification of informal settlements came from the government/IDB, municipalities and the local communities. The government's contribution was 50% while the municipalities contributed 40%. The remaining 10% came from local communities in the form of monetary contributions or sweat equity.

The Habitat Program's innovation stems from the fact that in line with the strategies of the National Development Plan, it provided capacity building for municipalities. These included technical assistance and training in strategy planning, investment management and urban planning. The capacity building was designed to enable the municipalities to support sustainable growth in the cities and to instil the necessary expertise among staff.

Outcomes

A total of 270 cities benefited from the activities of the Habitat Program. By 2005, the number of urban households without access to electricity had decreased by 5% to stand at just 1.4%. The program benefitted more than one million households annually. It improved the quality of life for poor households in the neighbourhoods that it targeted. A survey conducted following the electrification and the installation of public lighting systems revealed that 64% of the respondents felt safer.

Other benefits of the Habitat Program included the reduction of fires and accidents resulting from the use of candles and the improper, substandard wiring associated with electricity theft that was prevalent among low income urban communities in Mexico.

Sustainability

The operational sustainability of the Habitat Program is highlighted by the focus that it placed on counteracting unplanned, unsustainable urbanization and the measures taken to combat poverty. The urban planning and management training provided to municipalities improved their capacity to meet the demands and challenges of urbanization. The cities became more sustainable and better able to provide residents with the necessary social services and infrastructure.

Lessons Learned

The implementation of the program involved the participation of a wide range of stakeholders including the government, municipalities, utilities and members of the beneficiary community. Its considerable success may be attributed to its strong linkages to the National Development Plan. These linkages enabled the Habitat Program to benefit from having the full support of the government and its administrative authorities who actively championed its implementation.

Transferability

The Habitat Program as well as the planning and policy measures manifested in Mexico's National Development Plan that made it feasible can be replicated. The prerequisites to the success of any program aiming to emulate its achievements in expanding access to modern energy for low income households include a commitment at national or local government level to combat energy poverty and ensure urban sustainability.

ENERGY MANAGEMENT: Planning (48)

Title of Best Practice	Compressed Natural Gas as a Transport Fuel for Poverty Reduction
City/Town	Dhaka
Country	Bangladesh
Source	http://content.undp.org/go/cms-service/stream/asset/?asset_id=2095740

Background

In 1997 as a result of increasing rates of motorization, air pollution in Dhaka the Bangladeshi capital reached levels 10 times higher than those stipulated in the World Health Organization air quality guidelines. Health care costs associated with air pollution were rising all the time. The importation of petroleum and petroleum products to meet the demand for fuel also placed severe pressure on Bangladesh's balance of payments. Addressing these twin issues became a priority for the government.

Bangladesh has vast reserves of natural gas and research had shown that vehicles running on Compressed Natural Gas (CNG) emitted less GHG than conventional petrol and diesel cars. This led to the instigation by the government of the Compressed Natural Gas as a Transport Fuel for Poverty Reduction. Rupantarita Prakritik Gas Company Limited (RPGCL) was given the responsibility for developing cost-effective ways to commercialize the use of CNG in the transport sector. RPGCL was also responsible for assisting the private sector by providing support in the design of refuelling stations, the awarding of contracts and the supervision, testing and commissioning of CNG stations. Other main project partners included UNDP and Environment Canada. UNDP assisted in the development of the infrastructure and capacity-building needed for CNG usage. Environment Canada provided RPGCL with expertise in clean fuel technology transfer, measurement of emissions, and capacity building and training.

Process and Innovation

The project commenced in 2001. Its implementation included activities intended to expand the use of CNG. Private sector investment was used to open CNG conversion centres and refuelling stations. With its vested interest in the project, the government put in place enabling policies and regulations. These included the replacement of auto-rickshaws with CNG vehicles and the conversion of all government vehicles to CNG. Buses that previously ran on diesel were also converted to CNG. The exclusive importation of CNG-operated buses (pictured left) further reduced demand for diesel.

Innovations included a North-South collaboration that brought together personnel from the CNG industry in Bangladesh with experts from Canada. The North-South collaboration enabled learning and interaction which proved very effective in facilitating information transfer.

Outcomes

The project with its move away from the use of expensive petroleum products resulted in greater affordability of transport for poor people, with lower fares as compared to other countries. Use of CNG reduced operating costs of vehicles resulting freeing household income. Other outcomes included the creation of new businesses and job opportunities in CNG conversion centres, refuelling stations (pictured left) and spare parts supply. As a result of the project, CNG is now the most frequently used transport fuel in Dhaka, with significant increases in other parts of the country.

More than 10,000 people found employment in enterprises associated with the CNG industry. The project also brought about health costs savings for poor people who are the most vulnerable to air pollution.

Sustainability

The project is economically, environmentally and financially sustainable. With CNG becoming the most commonly used transport fuel in Dhaka, fuel costs have been reduced by up to 60%. Government expenditure on the importation of fuels reduced significantly freeing up finances for other important public expenditure. As expected, the project led to improvements in air quality in Dhaka. It was estimated that reducing GHG and particulate matter concentrations to Bangladeshi national air quality standards resulted in 3,580 fewer premature deaths. The project also resulted in an estimated 10 million fewer restricted activity days and 87 million fewer respiratory symptom days per year. The economic benefits associated with the improved health outputs in Dakar range from US$ 60 million to US$ 270 million per year.

The active participation of the private sector means that the project was financial sustainable and not totally reliant on grant funding. Businesses became key players in the fledgling industry taking the initiative to convert diesel operated vehicles to CNG.

Lessons Learned

Policy support from the government was essential for the success of the initiative. This support was evident in the banning of two-stroke auto-rickshaws. As a popular means of public transport in Bangladesh, the rickshaws were responsible for substantial levels of pollution. The government's support also ensured the successful conversion of all government diesel powered buses and official vehicles to CNG and guaranteed the availability of budgetary allocations for the development of the new CNG infrastructure.

Transferability

The project successfully demonstrated the potential of CNG to be used as a safe and financially viable transport fuel. It has the potential to be replicated in other countries with natural gas reserves reducing expenditure on the importation of petroleum products for use in the transport sector.

ENERGY MANAGEMENT: Planning (49)

Title of Best Practice	Ecocabs Dial-a-Rickshaw Scheme
City/Town	Fazilka
Country	India
Source	http://www.unhabitat.org/downloads/docs/11804_1_594697.pdf

Background

Fazilka is a city with a population of 67,500 located in the state of Punjab. The city was the site of the Ecocabs scheme the world's first dial-a-rickshaw scheme. The scheme was initiated to improve the city's chronically disorganized rickshaw transportation system, enhance connectivity and to provide an affordable, comfortable means of mobility for the low income residents.

It was implemented by the Graduates Welfare Association (GWA). GWA is a local NGO that focuses on issues relating to education, employment, the environment and energy.

Process and Innovation

The scheme was launched by GWA in 2008. It is essentially a cycle rickshaw service available through a network of call centres similar to the sort of network which would constitute a dial-a-cab service. On its launch, GWA brought together 500 rickshaw drivers in Fazilka operating through five dedicated call centres.

The scheme's rickshaws are designed based on ergonomic principles, are light-weight and able to carry extra luggage. The rickshaw drivers received mobile phones to help their communication with the call centres and clients.

While GWA was responsible for the operation of the scheme, the municipal government also participated helping set up Ecocab stands at different strategic locations throughout the city. At the primary stage, the scheme's focus was mainly on improving pro-poor access to rickshaws. This was subsequently followed by improvements to the quality of the services provided under the scheme.

The Ecocab scheme's main innovation was its financial model. This allowed rickshaw drivers to become stakeholders on paying an initial membership fee which was fixed at just under US$ 185. Rickshaw drivers were able to access a loan from the Reserve Bank of India to help pay the fee at an annual interest rate pegged at 4%. The repayments on the loan were lower than the fees that the drivers would have ordinarily paid to rent the rickshaws. The drivers were also able to earn additional income from advertisers whose messages were carried on the vehicles.

Outcomes

By 2011, the number of Ecocab call centres had been increased from the original 5 to a total of 9 each covering an area of one square kilometre. In addition to providing affordable, environmentally friendly transportation to the urban poor, the scheme has also provided employment opportunities for people from the same demographical background.

The drivers included in the scheme receive benefits including free health check-ups, discounted cost of medicines, free legal assistance and better rickshaw parking facilities. Free education and scholarships for are also offered to drivers' school-going children.

The scheme has won several accolades during the time that it has been operational. In 2011, it won the National Award of Excellence in the area of Non-motorized Transport from India's Ministry of Urban Development.

Sustainability

The Ecocab scheme is operationally sustainable and has significantly reduced transportation costs. Rickshaw drivers working under the scheme are able to break even within 10-12 months of becoming stakeholders. The income that they receive from ferrying passengers is supplemented by revenues accrued from advertising. The scheme's environmental sustainability is ensured by the fact that the rickshaws are based on zero-emissions technology substantially reducing pollution in Fazilka and contributing to better air quality.

Lessons Learned

The Ecocab initiative demonstrated that informal non-motorized technology can be used to promote reliable, sustainable and inclusive mobility for lower income groups. The success of the scheme hinged largely on making the drivers real stakeholders who were able to draw tangible benefits from their ownership of the project. The full cooperation of the municipal government was also an important factor in the success of the program.

Transferability

The use of non-motorized technology by the Ecocab scheme resulted in a reduction of the overall costs of implementation. This means that the scheme can be successfully replicated in other towns and cities without major financial outlay. The Punjab state government has already replicated it in 22 other cities. There are also plans to implement similar schemes in other Indian states.

ENERGY MANAGEMENT: Planning (50)

Title of Best Practice	Mexico City Bus Rapid Transit System
City/Town	Mexico City
Country	Mexico
Source	www.ine.gob.mx/descargas/calaire/metrobus_bca.pdf

Background

The transport sector is the main source of GHG emissions in urban centres. Mexico City is one of the largest cities in the world and in the year 2000, the transport sector alone was responsible for just under 40% of the 51 million tons of carbon dioxide emissions in the city. This necessitated the implementation of the Green Plan by the municipal government. One of the pillars of the Green Plan was the provision of a more environmentally friendly public transportation for the city's residents through the introduction of a Bus Rapid Transit (BRT) or Metrobus system.

The specific objectives of the Metrobus system were to improve mobility in the city by establishing an efficient, safe, convenient and effective modern mass transit system and to reduce travel times while contributing to the mitigation of climate change. Work on the system commenced in 2002 and was a collaborative effort between the municipal government, the World Resources Institute's Centre for Sustainable Transport (EMBARQ), the Mexican NGO CEIBA, the World Bank and the Shell, Caterpillar and Hewlett Foundations.

Process and Innovation

BRT systems are characterized by dedicated bus lanes and boarding stations where passengers pay fares prior to boarding the bus. This allows them to travel at higher average speeds than traditional bus systems as they are not affected by traffic. Transfer times at stops are also significantly shorter. When it was opened in 2005, the Mexico City Metrobus infrastructure consisted of two lines. The first line runs from the north of the city to the south along the city's longest arteries. The second line runs from east to west. The Metrobus system was approved as a CDM project in 2009 and a third line was opened in 2011.

In terms of innovation, the Metrobus was the first transport system in Mexico City to have proper facilities for people with disabilities with stations and buses meeting the highest international norms and standards for disabled access. It included facilities in stations that provide courtesy doors, ramps, pedestrian audio-traffic signals, guides for the blind and poorly sighted as well as Braille panels. The buses have allotted spaces with safety-belts for wheelchair-bound passengers, acoustic alarms, bright handrails and 'door closing' illuminated announcements. The Metrobus system also promotes social inclusion by allowing free entry to seniors over 70 years of age, disabled people and accompanied children below 5 years of age.

Outcomes

During the first six years of operation, the system's first line was able to reduce carbon dioxide equivalent emissions by 300,000 metric tons, corresponding to US$ 800,000 of income for the city in CDM finances. The articulated buses (pictured below left) and bi-articulated diesel buses significantly reduce passenger exposure to tailpipe emissions produced by running vehicles.

The system reduced travel times by 40% and also reduced the number of accidents by 30%. An additional outcome of the system was that it enabled urban poor customers including cash poor senior citizens over the age of 70 to benefit from access to safe, accessible and reliable public transport. The Metrobus system transports an estimated 187 million passengers annually.

Sustainability

Economically, the introduction of the BRT has resulted in reduced travel times and increased productivity and access to employment opportunities for low income residents of Mexico City. Socially it has been associated with more equitable access throughout the city, reduced accidents, traffic fatalities and injuries and increased civic pride and sense of community. BRT's environmental sustainability is reflected in reduced emissions of air pollutants and reduced noise pollution. It has also alleviated the associated adverse health impacts of these forms of pollution.

Lessons Learned

The introduction of BRT to Mexico City illustrated that planning and public participation are crucial ingredients for the success of a city's eco-transportation plan. Awareness raising sessions were held to introduce the concept to the city's inhabitants to ensure that their buy-in was obtained. The Metrobus system also benefitted immensely from the municipal government's 15 year Green Plan which allowed precise goal-setting to accommodate inherently slow processes such as behavioural change and adjustment to new infrastructure.

Transferability

Many large cities in developing countries face high levels of traffic congestion and enormous demands for public transport as well as the challenge of reforming car-oriented cultures. BRTs have the undoubted potential to serve as a cost-effective solution to these urban challenges. According to the International Energy Agency, if BRT systems were to be established in the world's 1,000 largest cities, it would reduce carbon dioxide emissions by up to 0.5 metric gigatons between 2010 and 2050. This is equivalent to one-sixth of all carbon dioxide reductions that can be achieved in the transportation sector.

BRT is gaining momentum as a sustainable public transportation solution for cities around the world. The city of Bogotá in Colombia runs a highly successful BRT. The success of the Metrobus system has already led to its replication in Guadalajara, Mexico's second largest city. Mexico City continues to expand its own system. Two further lines were scheduled to be opened in 2012.

ENERGY MANAGEMENT: Partnerships (51)

Title of Best Practice	Sustainable Energy for Tshwane
City/Town	Tshwane
Country	South Africa
Source	www.cityenergy.org.za/files/resources/soe/CTMMSOE.pdf

Background

About 33% of the municipality of Tshwane's 620,900 households are located in informal settlements. Unemployment is estimated at about 19% and energy services to low-income households have historically been inadequate. Many households in the north of the municipality used alternatives to grid electricity for heating, cooking and lighting representing a strategic focal point for the provision of modern energy services.

Starting in 2003, the city has participated in the Sustainable Energy for Environment and Development (SEED) program organized by Sustainable Energy Africa a local NGO. SEED's aim is to build the capacity of South African municipalities around energy issues. Tshwane's SEED project promotes the integration of sustainable energy and environmental approaches and practices into the municipality's operations. It was implemented by the municipality of Tshwane's interdepartmental committee in partnership with the South African Department of Minerals and Energy.

Process and Innovation

The municipality, the Department of Minerals and Energy and Sustainable Energy Africa formed the Sustainable Energy for Tshwane (SET) committee. The activities of the committee were based on an implementation plan and SEED's Cape Town declarations.

Under the Cape Town declarations, the city of Tshwane made a commitment to provide sustainable energy that has health benefits, to reduce carbon dioxide emissions for cleaner air and to promote general awareness among community members on renewable energy and energy efficiency. This included enhancing energy sustainability, accessibility and affordability to residents with the municipality facilitating the supply of safe, reliable and affordable energy services to households in informal settlements.

SET facilitated the city of Tshwane's participation in the *EnerKey Project*. The *EnerKey Project* is a research based initiative that covers issues such as sustainable energy, integrated energy modelling, traffic and mobility. *Enerkey* also looks at the socio-economic aspects of energy and assesses appropriate technologies aimed at developing GHG inventory tools in energy supply systems. These were all in line with SET's objectives and helped the city in its efforts to achieve its sustainability goals.

Outcomes

The SET partnership initiated energy efficiency awareness-raising activities including the distribution of compact fluorescent lamps (CFLs) and residential load management. Households were also legally connected to electricity under the national government's Free Basic Electricity (FBE) social tariff.

SET also undertook a qualitative assessment of the environmental impacts of energy use in the municipality. The most significant energy-related factors affecting air quality and climate change in Tshwane was found to be vehicular traffic as well as industrial and household consumption of fossil fuels, coal and traditional biomass.

SET promoted the use of LPG (pictured above left) in low income households. Other outcomes of the partnership include the successful retrofitting of street lights in disadvantaged wards of the municipality. SET also developed an air quality management plan and a sustainable energy strategy and instigated a tree planting carbon sequestration project.

Sustainability

SET's activities are environmentally sustainable. The partnership enabled the municipality to come up with an emissions reduction strategy for fuel burning which enabled the supply poor households with low smoke alternatives to the domestic fuels they were using. Households were supplied with gas cookers and gas cylinders. The municipality also put in place measures that will allow the integration of energy efficiency measures in new low-cost housing areas including solar passive designs and better insulation. SET led to the amelioration of global warming through carbon sequestration and sustainable energy use which has resulted in financial savings, savings on electricity consumption and substantial reductions in air pollution.

Lessons Learned

The SET partnership illustrated the importance of coordinating project activities that reflect and complement the priorities of national departments. In the case of SET, the initiatives that were prioritized including the implementation of FBE, the promotion of energy efficiency, the provision of public lighting in disadvantaged neighbourhoods and the development of an air quality management plan all complemented the work of ministries such as the Department of Mines and Energy and the Department of Housing.

Transferability

The activities that were undertaken by the SET partnership all encourage sustainable energy use and energy efficiency. These are recognized as major factors in demand side management which is an important consideration for energy poor urban communities. The partnership's activities are highly replicable both within South Africa and in other countries where the right framework and support structures are in place.

Conclusion

The best practices documented in this casebook have illustrated that the greatest hindrance to access to modern energy services including electrification and clean cooking fuels the urban poor is the considerable upfront costs. The fact that informal settlements are often categorized as illegal settlements means that modern energy infrastructure and products are routinely targeted at recognized urban neighborhoods and rural households to the exclusion of low income urban populations. The resultant energy poverty permeates every aspect of human life impacting negatively on the livelihoods of poor households in cities and towns. All the best practices prove that access to modern energy services can indeed have tangible positive effects on the lives of the urban poor.

	Improved Livelihoods and productivity	Financial Savings	Security and Safety	New Enterprise Opportunities	Reduced Indoor Air Pollution	Social Inclusion	Reduced Environmental Degradation
Electricity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Cooking Fuels	Yes			Yes	Yes	Yes	Yes
Improved Cook Stoves	Yes	Yes		Yes	Yes	Yes	Yes
Energy Efficient Housing	Yes	Yes				Yes	Yes
Energy Efficient Appliances	Yes	Yes			Yes		Yes
Waste to Energy	Yes				Yes	Yes	Yes
Urban Mobility	Yes	Yes				Yes	Yes

The Benefits of Access to Modern Energy

Access to modern energy can be associated with a wide range of social, economic and environmental benefits. These include greater potential for educational achievement due to better lighting, savings in time and energy spent gathering traditional cooking fuels, potential for improved access to information and digital connectivity, improved security and safety, reduction in the incidence of hazardous fires and improved health services as wells as improved indoor air quality. It also enables the establishment of new businesses in informal settlements. These businesses include welding, battery charging and electronics repairs which provide opportunities for the urban poor to increase their incomes.

According to a UN-Habitat report released in 2009, in developing countries, over 50% of foreign exchange earnings go to importing fossil fuels which often only a minority can afford. Air pollution from the use of these fuels accounts for 5% to 20% of GDP annually. The urban mobility case studies illustrate that improved node to node connectivity with the provision of affordable and comfortable transport services improve the living conditions of low income groups reducing their transport costs and giving them access to jobs and training opportunities most of which are located outside of informal settlements.

Urban energy consumption has had a huge impact on surrounding forest resources in developing countries. The cutting of trees for firewood and charcoal for urban use is often done intensely and in an uncontrolled, unsustainable manner. The best practices promoting the use of clean cooking fuels, improved cook stoves, solar water heaters, solar cookers and briquettes have shown that short of imposing strict and often unenforceable controls on the cutting down of trees, phasing out traditional biomass fuels and encouraging the use of energy efficiency measures and renewable energy technologies provide an effective means of curbing rampant deforestation.

The benefits accrued from the best practices are not restricted to low income households and the environment. The utilities and companies involved in the production and distribution of energy derived substantial benefits from extending their services and products into informal settlements. These include reduced technical and commercial losses caused by electricity theft and improved fiscal outcomes due to reduced service costs and improved bill recovery which result from the regularization of low income households. The demand side management resulting from energy efficiency measures also has positive outcomes for the utilities reducing the strain on the electricity grid.

The best practices illustrate that the challenge of high upfront costs of modern energy services can be addressed by introducing imaginative, user-friendly payment schemes. They also show that successful strategies for promoting access to modern energy for the urban poor are anchored on a number of guiding principles or critical success factors. These include income generation for sustainability, community awareness for longevity and impact on policy for credibility. To these can be added the following;

- Monetary and opportunity cost savings;
- Strong community involvement;
- Enabling environments provided either by local or national governments;
- Proper and timely implementation; and
- Strong stakeholder collaboration;

Nearly all the best practices demonstrated the importance of community participation and how this contributes to the success of a project by ensuring both ownership and commitment from beneficiaries which are crucial for the achievement of long-term sustainability. They recognized the complexity of urban communities and promoted a participatory approach to urban planning and management based on clearly identified community needs. In the majority of cases, the best practices served to support the municipality or national urban agenda and promote multi-stakeholder participation enabling different players to bring into play their unique skills and experiences. Other factors that emerged as being of vital importance include strong political will from local or national government for the program, awareness-raising and project promotion to bring the community on board. Equally important is the presence of an enabling environment with regulatory frameworks that support energy access for the urban poor.

For slum electrification, the best practices show that the replacement of punitive measures such as arrest and disconnection with convincing beneficiaries on the benefits of legal connections does work. Successful slum electrification is significantly facilitated by the presence in a city or country of enabling policies on informal settlements or ongoing slum upgrading initiatives. Energy efficiency driven practices such as the replacement of inefficient incandescent lights with CFLs are often associated with higher income households. However, it has been proven that using innovative approaches, retrofitting exercises can also be successfully applied in low income neighborhoods.

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